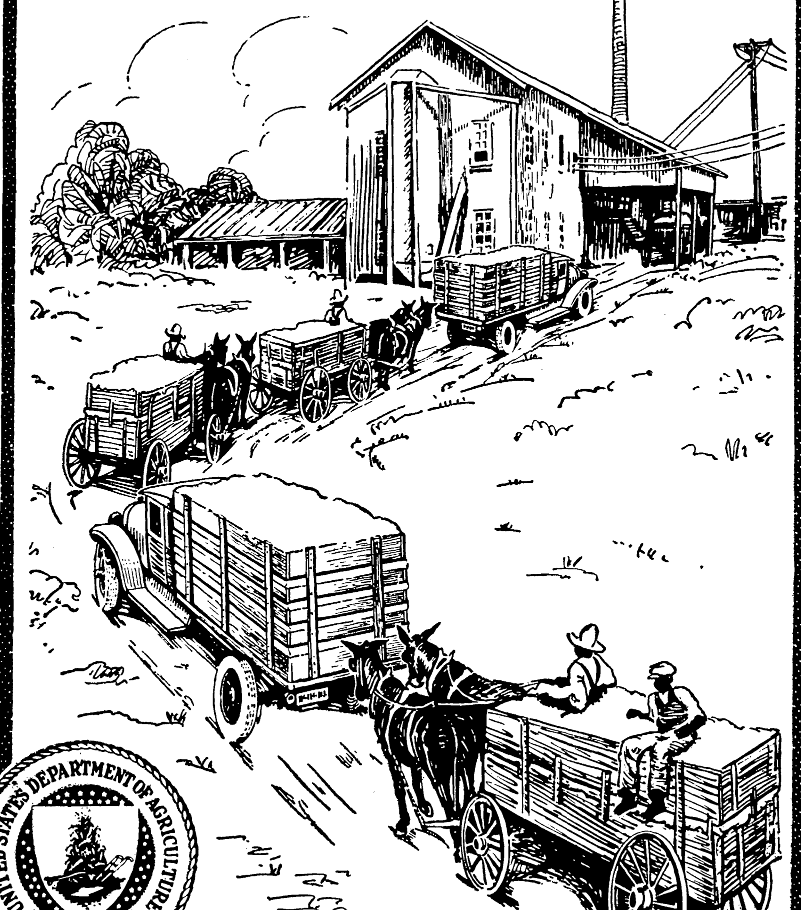
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1748

GINNING COTTON



UNITED STATES DEPARTMENT OF AGRICULTURE 1862 1889

IMPROVED PRACTICES in handling and ginning seed cotton will result in improved quality in the ginned lint and relatively better prices to the cotton farmers. It is the responsibility of the farmer to deliver cotton to the gin in the best possible condition, and it is incumbent on the ginner to see that the quality of the lint is not lowered by improper ginning methods. The moisture content of seed cotton is an important consideration in good ginning; if it is too high the cotton should be artificially dried before being ginned.

The development of commercial cotton-ginning plants, utilizing somewhat costly machinery of large capacity in order to do the work cheaply, has emphasized the importance of speed in ginning. As a result, the ginners have had a tendency to gin each load of cotton as rapidly as possible in order to get the largest return on their investment in equipment, and in this they have been encouraged by the farmers, who wish to wait no longer than necessary to have their cotton lint and seed ready for sale. In the effort to gin quickly, the quality of much of the American cotton has been injured.

That the good qualities in the cotton brought to the ginning plant can be preserved by proper ginning equipment and methods has been demonstrated at the Department's cotton-ginning and fiber laboratories, and the increase in cost of such service over more hasty ginning is less than the increase in value of the lint. This bulletin discusses methods and equipment for handling and processing seed cotton from the time of harvesting until the lint is baled so as best to retain the desirable qualities of the fibers.

This bulletin supersedes Farmers' Bulletin 1465, Cotton Ginning.

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GINNING COTTON

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INTRODUCTION

Cotton ginning includes the cleaning and other preliminary processes involved in preparing seed cotton, as well as the separating of the fibers from the seed. When harvested, cotton usually contains dirt, hulls, leaf fragments, and other material which must be removed if the ginned lint is to have the highest market value.

With present-day gin machinery it is not possible to produce from roughly harvested seed cotton lint equal in quality to lint from carefully picked cotton. Therefore, a farmer should see that all his cotton is picked as carefully as possible.

Cotton farmers, as well as others connected with the cotton industry, benefit from good ginning and suffer from poor ginning. Manufacturers will not knowingly pay cotton prices for moisture, dirt, and so forth, nor will the market absorb poorly ginned, rough, or damp lint unless the price is reduced. Each person connected with the various channels through which cotton passes tries to protect himself, and ultimately, in dollars and cents, the cotton grower bears the brunt of every penalty.

HOW FARMERS CAN HELP TO IMPROVE GINNING

Cotton farmers can promote good ginning by furnishing the ginner with cotton in good ginning condition. They can also demand that the ginner employ those ginning methods that will best preserve lint quality. Such action should make it possible to obtain a higher price in the local market, and, combined with cooperative efforts, to promote a greater utilization of cotton through new uses and an extension of present uses.

[1] Acknowledgment is due the following manufacturers of ginning machinery for their courteous and helpful assistance: Continental Gin Co., Gullett Gin Co., Lummus Cotton Gin Co., The John E. Mitchell Co., The Murray Co., The Boardman Co., and The Phelps Co.

Tests conducted by Department workers show that excessive moisture in seed cotton markedly reduces the quality of the lint and makes it difficult to sell without the severe penalties that sometimes amount to 25 percent of the possible value of the bale. If the cotton is too moist because of greenness or exposure to rain or dew, in clear weather it may be spread on sacks, tarpaulins, racks, or galleries and exposed to the sun. Care must be taken to keep it from getting wet again. Such drying involves a great deal of work and is expensive. A Philbrick drier (fig. 1) may be used, consisting of screen-bottomed trays on racks, and a shed in which to stack the trays in bad weather. The first cost is several hundred dollars. This drier has only a limited capacity and cannot be used in wet weather.

The period of exposure to the sun necessary to insure improved ginning depends on the moisture content of the cotton, the depth of the layers, the temperature and relative humidity of the atmosphere,

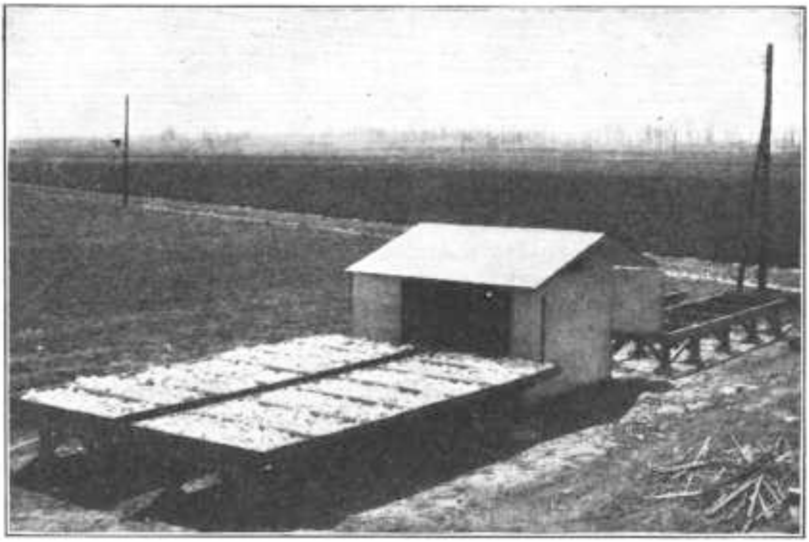

FIGURE 1.—Philbrick drier for seed cotton.

the number of times the cotton is turned or aired, the staple length of the cotton, and other factors. The cotton should be exposed in layers from about 4 to 8 inches in depth to obtain effective sun-drying by any method. If the cotton is very green or wet it should be exposed from 15 to 20 hours. If it is only slightly green, damp, or dew-laden, drying for 7 to 15 hours is usually enough. Except when placed in screen-bottomed trays, the cotton should be turned or aired occasionally during exposure to insure the uniform drying of all locks. These periods of exposure may be somewhat less for short-staple than for long-staple cotton, because from a ginning standpoint a moisture content that is excessive for long cotton is not necessarily so for short cotton.

If it is not practicable to handle damp or wet seed cotton enough for satisfactory sun-drying, it is a good practice to at least sun-dry the morning dew-laden pickings. The afternoon pickings, which

usually are drier, may be placed in the wagon or cotton house and the sun-dried morning pickings added to them at the end of the day.

It is a bad practice to place green, damp, or wet cotton with dry cotton in a wagon and take it to the gin immediately. The side of the bale containing the cotton with excessive moisture will be lower in quality than the side ginned from the drier cotton, and the value of the bale will be determined on the basis of its low-quality side.

Storing green, damp, or moderately wet seed cotton on the farm before ginning generally improves the quality of the ginned lint, if the cotton is turned and aired during storage. If it is not turned and aired, especially if it is wet, there is danger that it will "heat" to such an extent that the quality of lint will be lowered as well as the germinating and milling qualities of the seed.

The period of storage needed to dry cotton depends on the moisture content of the cotton, its staple length, its depth and compactness, the temperature and relative humidity of the atmosphere, the rate of air circulation, the number of times the cotton is turned and aired, and other factors. The cotton should be stored loosely and in as shallow piles as possible, 2 to 4 feet being the depth used by many farmers. If the weather is dry and hot, a period of 1 week is usually enough but the damper the weather the longer will be the storage period required. If the weather continues damp so long that the cotton is likely to deteriorate, it should be taken to a gin that has a mechanical drier. Storage of cotton before ginning is a questionable practice in damp regions. Damp or wet cottons should never be stored in the same bin with dry or normal-moisture-content cotton.

Where rains occur frequently during the cotton-picking season, as in the eastern part of the Cotton Belt, it is especially important that cotton be picked as soon as practicable after the bolls open. Cotton left in the field and exposed to such weather is discolored, is contaminated with soil, and is soil-stained, all of which lower the grade and character; if it is damp, it should be dried before being ginned.

Early pickings ordinarily should not be mixed with later pickings for ginning, as the later pickings are usually lower in quality and cause the lint of the entire bale to be sold at the price of the lower quality.

Tenant labor, living on the farm, generally will pick cotton better than will transient pickers, who are concerned principally with obtaining the most money for their labor. It has been observed that the lint ginned from cotton picked by farm labor was from 1 to 2 grades higher in quality than that from cotton picked by transient pickers in the same field on the same day. The lower grade was the result of greater proportions of burs, stems, partly opened and even green bolls, immature and weevil-damaged bolls, and dampness in the cotton picked by the transient labor.

MACHINERY AND PRACTICES AFFECTING GINNING

In order that benefits may result from improved handling of seed cotton by the grower, the ginners must help to preserve the inherent quality of cotton by adopting the very best ginning practices and methods. When this is done, the cotton farmers and others concerned should become adjusted to charges that are in keeping with the services rendered.

Before discussing some of the relationships between ginning machinery and lint quality, and ways by which the ginner may give the farmer a better service, it seems desirable to describe in general the processes used in ginning cotton, even though these may be familiar to many.[2]

In view of the fact that only a fraction of 1 percent of all the cotton-ginning plants in the United States are equipped with roller gins,[3] the discussion in this bulletin is confined to saw gins. In 1933, according to the Bureau of the Census, there were 13,543 active cotton gins in the United States.

COTTON-GINNING PROCESSES

The processes associated with ginning include the entire series of handling operations from harvesting the seed cotton to baling the ginned lint and disposing of the seed at the cotton-ginning plant. Figure 2 shows the processes that are available for ginning cotton, and indicates possible routes that the seed cotton may follow before the bale is wrapped and the seed is housed or returned to the farmer.

The ginner has a wide choice of machinery for preserving or improving the quality of the farmers' cotton. If the seed cotton is too green, damp, or wet to gin, the ginner can dry it in a drier before passing it to the cotton-gin telescope that carries it to either a separator or pneumatic elevator.

In case the gin is equipped with a mechanical system of feeding, the cotton may undergo a precleaning process which may involve the use of a drier, cleaners, and extractors. The advisability of using these machines depends on the condition of the cotton and whether it has previously been processed by a drier or an air-line cleaner. Following this special processing, the cotton is handled by a separator that discharges it to any or all of the prefeeding processes, which are similar to the special processes. Whether one of these is used depends upon the condition of the cotton and the use of previous equipment. Drying is usually accomplished at only one of these points, but cleaning and extracting may be done at all.

From the prefeeding processes of the mechanical system and the pneumatic elevator of the pneumatic system the cotton may be discharged to some one of the feeder units shown in figure 2, the selection of which should depend on the condition of the cotton and the treatment previously received. From the feeders the cotton passes to the gin stands, where the fiber is separated from the seed. The lint is discharged to the press through the customary routes and the seed to the seed hopper or seed house.

It may be seen that many different types and combinations of machinery may be used in ginning cotton, and it is advantageous for both the farmer and the ginner to know the effects of the different appliances on the quality of the ginned lint.

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[2] See also mimeographed reprint, Bureau of Agricultural Economics, Problems and Research Methods in Cotton Ginning.

[3] For information concerning roller gins the reader is referred to Department Bulletin 1319, Ginning Pima Cotton in Arizona.

DRIERS FOR SEED COTTON

Moisture in the seed cotton is one of the most important factors affecting gin operation and the quality of the ginned lint. Need for means of removing the excess moisture in order to promote good ginning is emphasized by the fact that generally weather conditions in the Cotton Belt, particularly east of the Mississippi River and in

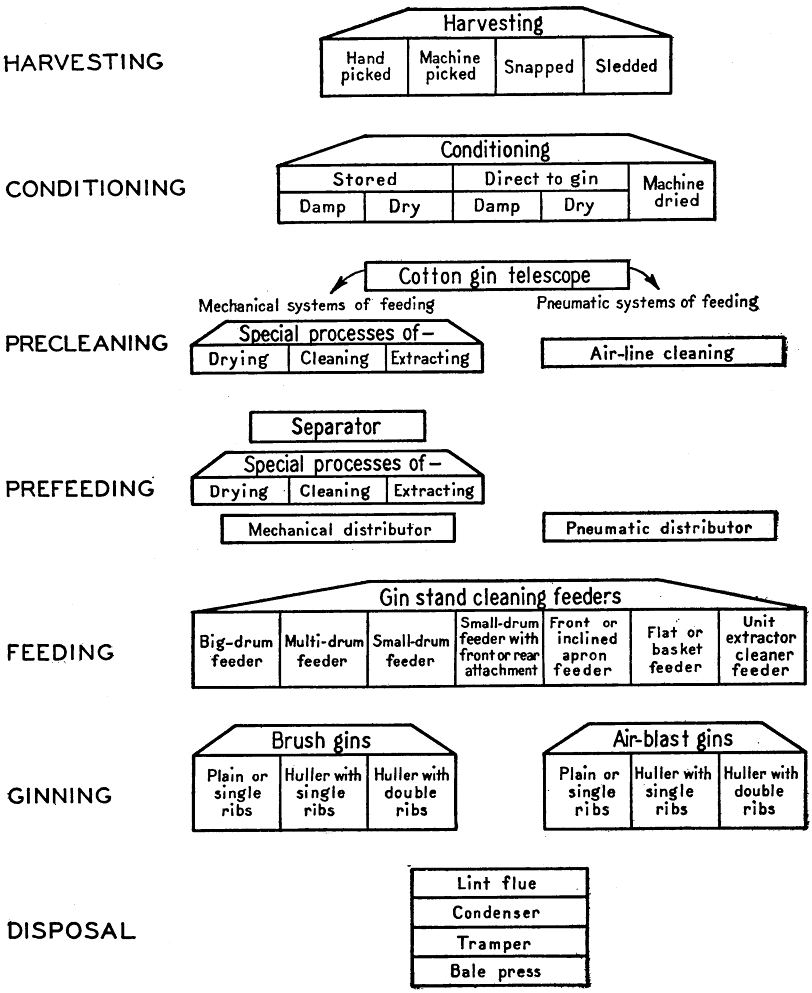


FIGURE 2.—Diagram of processes involved in the ginning of cotton.

the Delta sections adjacent on the west, are such that a considerable portion of the crop is ginned in a green, damp, or wet condition, which interferes with good ginning.[4]

Of the crop of 1932 more than a half million bales or about 35 percent of the cotton $1\frac{1}{16}$ inches and longer, and more than 2 million bales or about 20 percent of the cotton shorter than $1\frac{1}{16}$ inches, were green,

[4] See Effect of Artificially Drying Seed Cotton Before Ginning on Certain Quality Elements of the Lint and Seed and on the Operation of the Gin Stand. (Unpublished manuscript.)

damp, or wet and therefore not in condition to gin well. In 1931, a season of relatively low rainfall, 24 percent of the bales of the longer cotton and about 8 percent of the bales of the shorter cotton were too damp to give best ginning results. During the 10 years next preceding 1933 more of the cotton-ginning seasons corresponded in weather conditions to 1932 than to 1931. Even in a relatively dry season, much of the early harvested cotton is too damp to allow the best operation of ginning machinery and yield best quality of sample.

Moisture in seed cotton varies from section to section in a given season and also during the season in a given area. The estimated number of bales of the longer staple cotton ginned from seed cotton with excess of moisture in 1932 was as much as 40 percent in Mississippi and as low as 4 percent in Arizona; and of the shorter staple cotton, approximately 40 percent in Georgia and only 3 percent in Oklahoma.

Equipment for economically drying green, damp, or wet seed cotton at the gin is desirable from both the farmer's and the ginner's standpoints. Methods of reducing the moisture content of cotton on the farm have already been described, but as has been pointed out, those practices are cumbersome, entail considerable additional expense, and sometimes are not feasible. Processes and equipment to dry seed cotton artificially at the gin have therefore been developed. As a result the vertical drier [5] was devised in the cotton ginning and fiber laboratories of the Department, and the process of drying developed and patented between 1926 and 1928 by the agricultural engineers of the Department was applied to this drier. This and other types of driers and the process of drying were patented and dedicated to the public.

The Government design of vertical drier has horizontal floors (fig. 3) and different methods by which the damp seed cotton and the hot air can be delivered to the drying tower. There are no moving mechanical parts within the drying chamber, and after it has been warmed up for a few minutes it is ready for the continuous drying of as many as six bales of seed cotton per hour, which is as fast as cotton ordinarily can be ginned at a plant of average size. Satisfactory drying requires from 40 to 100 cubic feet of hot air for each pound of damp seed cotton, a period of exposure ranging from 15 seconds in the vertical drier to as long as 3 minutes in driers of other designs, and drying-air temperatures at or near 150° F. Because the fibers are much more susceptible to drying than are the seed, the relatively short period of exposure to the hot air puts the cotton into much better condition for ginning than the reduction in moisture content of the seed cotton indicates.

In operating the drier, the damp seed cotton is introduced into a continuous stream of hot air and conveyed by it to the top of the tower; then the cotton descends in a zigzag course from one floor to another, with repeated agitations against the warm walls which it strikes as it changes direction at each floor. In this manner the cotton is opened and fluffed up, and the drying is facilitated. Practically every lock of cotton receives the same treatment, and irregular feeding or large chunks of cotton are quickly spread out into a uniform and fluffy layer as the seed cotton descends through the tower. At

[5] Miscellaneous Publication 149, The Vertical Seed-Cotton Drier.

the base of the tower, the striking of the cotton against the screen is remarkably cleaning, and the dried cotton then passes on to the ginning machinery.

The vertical drier has proved to be one of the most practical and economical means of drying cotton. Operating costs range from 30 to 50 cents per bale. A practical installation is pictured in figure 4.

Tests with vertical driers have been made by the Department on numerous samples of cotton of different fiber lengths and of moisture contents ranging from less than 8 percent to more than 16 percent. The higher the moisture content of the seed cotton, the greater was

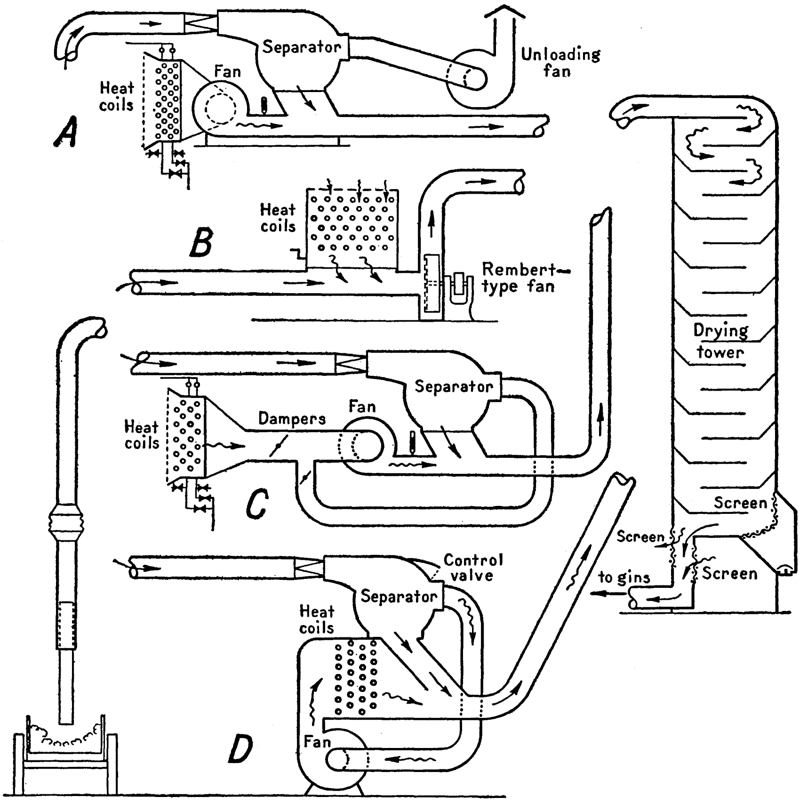


FIGURE 3.—Four methods of feeding vertical seed-cotton drier: *A*, Two fans and separator; *B*, single Rembert fan, split suction; *C*, single fan and separator, split suction; *D*, single fan and separator. Various types of blast-coil radiation may be used with *A*, *B*, and *C*, but only smooth iron-pipe coils with *D*.

the improvement shown in grade of lint, the less was the effect of the drier on staple length, and the greater was the moisture removal. As the drying temperatures were increased from 150° to 250° F., for a seed cotton of any given moisture content the grade of lint improved slightly; the staples were a little shorter because of the breaking of the fibers; and slightly more moisture was removed.

Cotton 1⅛ inches and longer having less than 8-percent moisture content and cotton shorter than 1⅛ inches having less than 12-percent moisture content showed little or no net improvement in quality as a

result of drying. With moisture content exceeding these limits, however, drying did improve the lint quality. A drying temperature of 150° F. gave the highest net benefit for each length group. Temperatures of 170° to 200° were used safely on very wet cottons, but temperatures higher than these are usually injurious to fiber length and other fiber properties.

Drying seed cotton at 150° F. improved the grade, on an average, from one-third of a grade for the longer staple cotton having 8.00 to

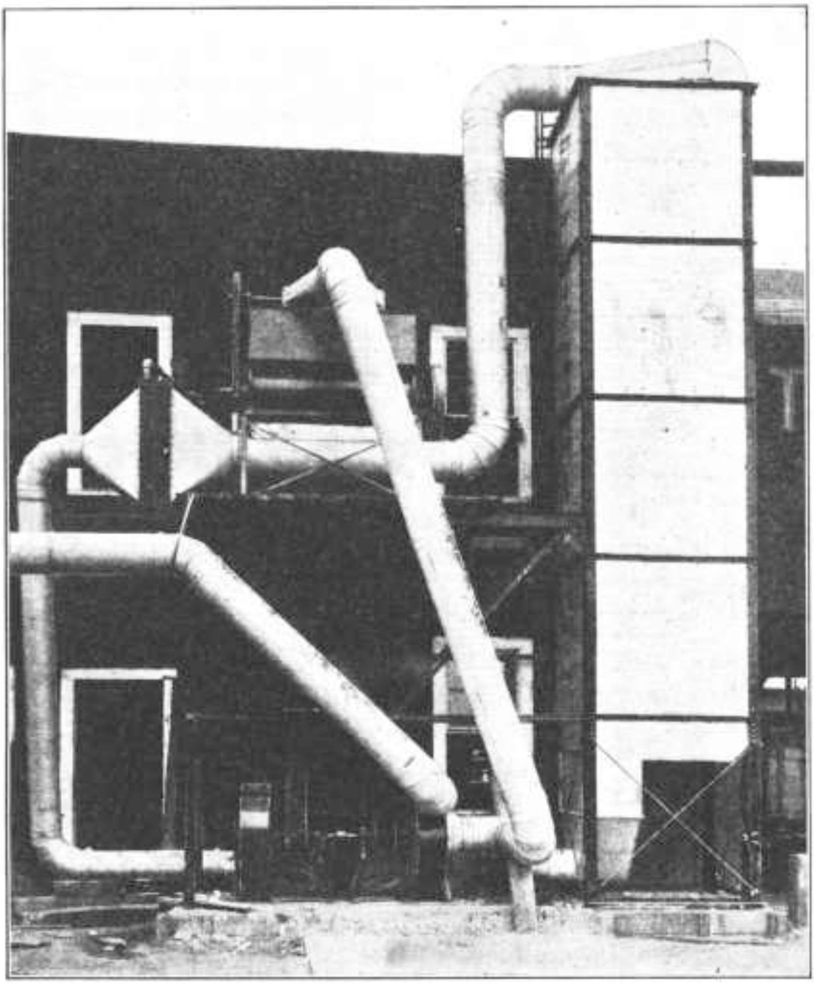


FIGURE 4.—A Government-designed factory-built vertical drier at an Arkansas cotton gin near the Mississippi River.

11.99 percent moisture and the shorter staple cotton having 12.00 to 15.99 percent moisture, to about one grade for both the longer and the shorter cotton having 16 percent and greater moisture content. Some of the individual samples of cotton having 16 percent and more moisture were so wet that drying improved the lint quality by about two full grades. For a group of 12 samples varying in length from

$1\frac{1}{8}$ to $1\frac{1}{4}$ inches, the quality of the lint was improved enough by drying to show, on an average, net benefits of about $2.50 per bale for the green, damp, or wet cotton having 12 percent or more moisture and of approximately $2 per bale for cotton of moisture content less than 12 percent.[6]

In a group of 11 samples of cotton varying in staple length from $1\frac{5}{16}$ inch to $1\frac{3}{32}$ inches, the damp or wet cotton showed net benefits from drying averaging about 70 cents per bale, whereas the drier cotton was reduced in value as a result of drying. These figures indicate that the longer the staple, the greater the increase in net value to be obtained by artificially drying damp or wet seed cotton.

Improvements in grade, particularly those made through preparation, for short-staple and long-staple wet cottons are shown in figures 5 and 6, respectively. The preparation improvements were enough to increase the classification by about one grade in each instance.

In addition to the quality benefits from drying, there are other advantages from both the farmer's and the ginner's standpoints. If cotton is to be dried, picking can be continued during damp or rainy seasons and in fields of heavy foliage, thus reducing weather damage to unpicked open bolls. As the gin operates at greater capacity with dried cotton, regardless of weather, the drying of green, damp, or wet cotton is important to the ginner. Drying also reduces power requirements as well as costly break-downs and chokages, and permits the cleaners, extractors, and feeders to operate more smoothly and more effectively. The ginner not only obtains a better capacity, but he can also preserve the lint quality. The germination and milling qualities of the seed are believed to be improved by drying.

COTTON HOUSES AT THE GIN

In some sections of the country it is usual to maintain seed-cotton storage houses near to and as part of the ginning establishments. Such cotton houses usually are constructed to provide (1) storage suitable for the natural conditioning of green, damp, or wet seed cotton, which must be turned from time to time or moved from bin to bin until it is in a condition suitable for ginning; (2) protection against bad weather, so that customers can unload their cotton quickly into individual bins and return to their farms without tiresome waits and exposure to rains or storms; (3) storage for one-variety crops, the seed of which is to be used for planting, when the customer wants to accumulate enough seed cotton to be ginned out in one lot without danger of its being mixed with other varieties; and (4) a temporary storing place for surplus seed cotton received during the day, so that it can be ginned by a night shift.

These cotton houses may be either rectangular or octagonal, and should have enough bins for usual requirements. The cotton can be placed in the bins by hand through the side windows, or mechanically by various systems. Cotton piping from an entry passage or hall in the house is provided so that stored cotton can be transferred by air directly to the gin. In rectangular cotton houses the Rembert type of fans are customarily used for unloading the seed cotton from the wagon and blowing it to the bin. Distribution to bins can be made by using a standard fan and separator combined, or by using a standard fan,

[6] Calculations of value are based on the average commercial prices for cotton of the various grades and staple lengths prevailing at Memphis, Tenn., during the season 1932-33.

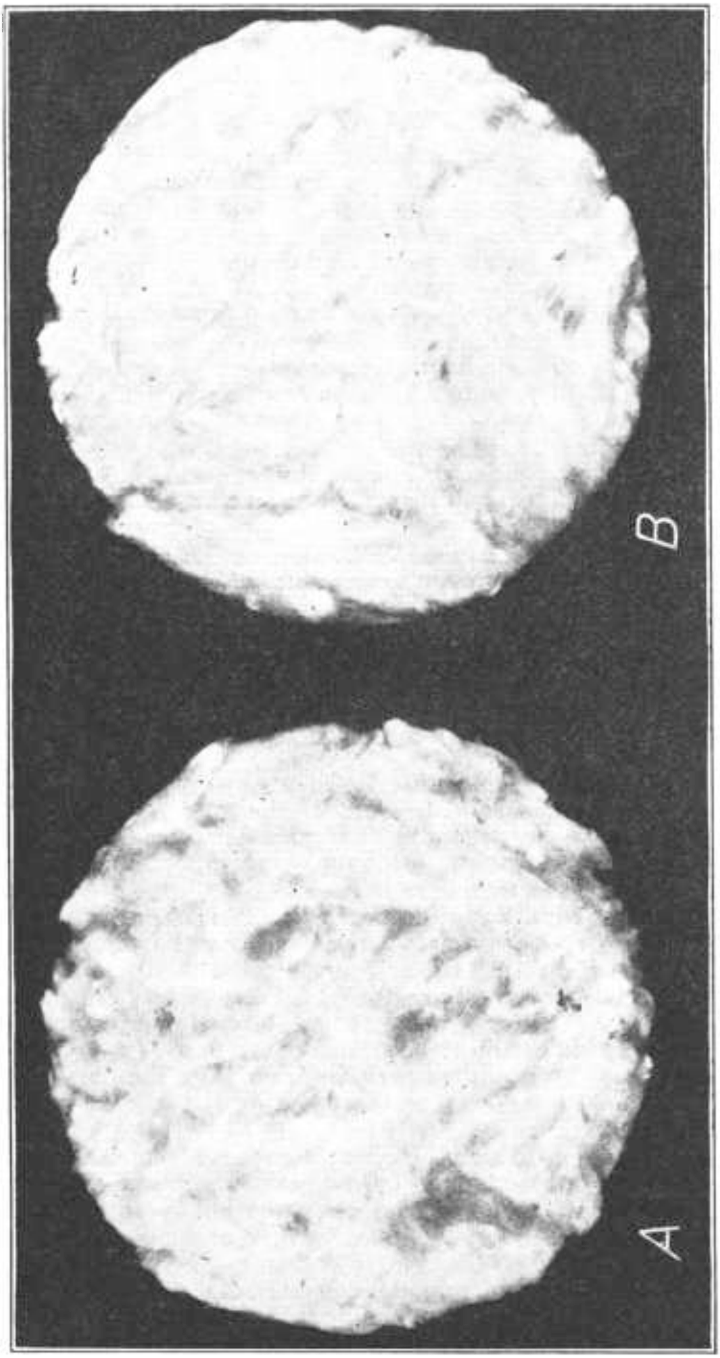


FIGURE 5.—Short-staple cotton ginned (A) from damp seed cotton and (B) from a portion of the same seed cotton after artificial drying.

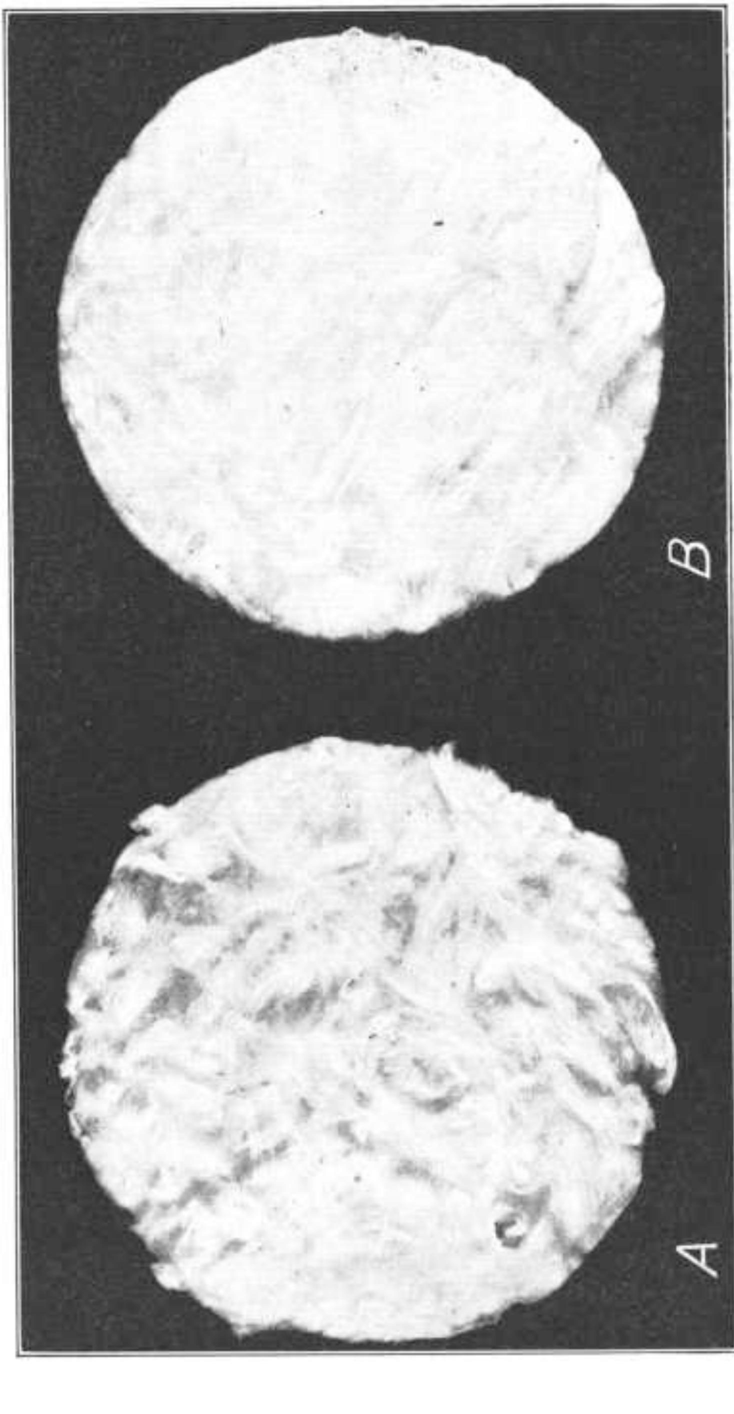


FIGURE 6.—Long-staple cotton ginned (*A*) from damp seed cotton and (*B*) from a portion of same seed cotton after artificial drying.

separator, and traveling belt fitted with gates for deflecting the seed cotton from the belt to the bin selected.

An octagonal cotton house, with the form of dropper ordinarily used for filling the bins by pneumatic means, is shown in figure 7. In such houses, the number of bins varies usually from 7 to 16, and the inclined chute beneath the dropper may be swung to discharge into any bin. The piping within the cotton house (shown by dotted lines) is a telescoping pivoted extension that reaches to the doorway of any bin and allows the cotton to be transferred to any other bin or to the cotton gin.

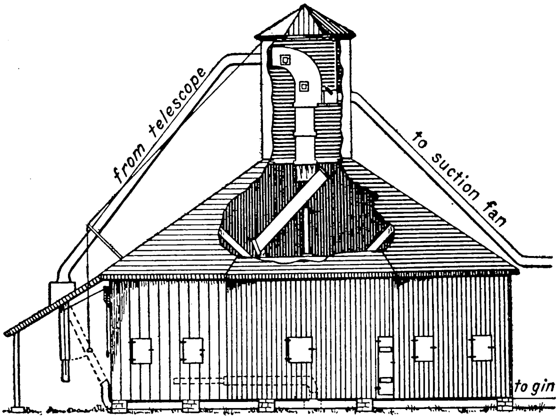


FIGURE 7.—Octagonal seed-cotton house, with pneumatic system for filling and emptying bins.

The bottom of the dropper is fitted with a canvas leg that draws together when the fan is exhausting, but when the fan suction is broken by operating the air valve the accumulated cotton drops by gravity through the canvas leg to the pivoted inclined chute. Thus the unloading of the wagon and the filling of the bins is intermittent, similar to the action of the pneumatic feeding system employed in cotton gins.

Cotton houses and seed houses should be made ratproof to prevent serious damages to their contents. It is best to do this work during the construction of the buildings, if possible.[7]

CLEANERS AND EXTRACTORS

Rough harvesting is responsible for intermingling with seed cotton portions of the cotton plants such as leaves, burs, and stems, and such foreign matter as sticks, weeds, and trash. Windstorms may fill the unharvested cotton with sand or dirt; rains and winds may together blow locks of cotton from the stalks into the mud; insects may damage the locks or seed; and cold weather may produce frost-bitten locks of cotton. In some sections cotton gins have been forced to handle as much as 3,000 pounds or more of material in order to gin out a 500-pound bale of lint, whereas 1,250 to 1,600 pounds of clean hand-picked seed cotton would provide a 500-pound bale of ginned lint. Using machines to remove this foreign material from the seed cotton at the gin with the least possible injury to the fiber is valuable in that it helps to maintain the grade of such cotton.

These machines are of two kinds, generally referred to as cleaners and extractors. Cleaning is the process of removing such small particles as sand, pin or pepper trash, and portions of shuck that can

[7] Farmers' Bulletin 1638, Rat Proofing Buildings and Premises, gives information on protection against rodents.

readily be passed through wire screens. Extracting is primarily the removal of large particles such as burs, sticks, stems, and whole leaves that cannot successfully be screened out, as well as the small particles removable by cleaners. Cleaning can be performed by extractors, but extracting cannot be performed by cleaners.

Cleaning and extracting processes, if properly used, are of far-reaching benefit to both farmers and ginners. These processes should not encourage a cotton farmer to adopt undesirable harvesting practices and methods but should be used to protect his crop against damage that would occur if his seed cotton were ginned without being cleaned and extracted. Cleaners and extractors are of great assistance to the ginner in protecting his gin stands from injury, by breaking up masses of packed or hard seed cotton and helping uniform feeding and handling.

As shown in figure 2, cleaning can be done in several positions between the wagon telescope and the distributors. Cleaners in those positions may appropriately be designated as master cleaners, to distinguish them from the small unit cleaners classified as gin-stand cleaning feeders. A master cleaner handles the entire volume of seed cotton passing through the system, whereas a unit cleaner handles only the cotton for one gin stand.

The cleaning screens in cleaners and extractors, if not checked both for condition and correct position, may be the cause of roughness, roping, and machining of the material. Broken screens are a frequent source of damage to the seed cotton. Screens too close to the cylinders may cause machining of the cotton and if too far away may produce roping and rolling.

The cylinders in cleaners and extractors often receive severe abuse from foreign matter, particularly rocks and sticks. Consequently the spikes, blades, or teeth of these cylinders require periodical alignment and straightening.

Elaborate processes of drying, cleaning, and extracting are frequently found in the precleaning position of some gins, and in the prefeeding position of others. It is not common practice to use them in both positions. Pneumatic systems are seldom found where the cotton is snapped, sledded, or machine-picked because the intermittent functioning of pneumatic systems generally makes impracticable any cleaning except that which may be obtained from air-line cleaners and from gin-stand cleaning feeders.

The inventions of equipment for handling seed cotton through piping by means of fans have been important factors in the improvement of ginning machinery and have led to the development of two types of cleaners which are technically known as "air-line" cleaners and "out-of-the-air" cleaners. Usually, unless cleaners are specifically referred to as air-line cleaners, it is understood that they are of the out-of-the-air type. The general construction of the two types is similar, but the air-line cleaners must be air-tight because they are connected with the suction piping of the ginning plant and leaks in the cleaner therefore would tend to prevent satisfactory movement of the seed cotton.

AIR-LINE CLEANERS

Air-line cleaners are designed to reduce the velocity of the air currents within the body of the cleaner so that agitation of the cotton

locks will shake out foreign matter and allow it to fall through a screening surface and then be discharged or trapped. Figure 8 shows diagrammatically the general forms of air-line cleaners. The axial-flow or single-cylinder type (fig. 8, *A*) has a cylindrical screen within the cleaner casing, and long paddles on a shaft passing through the center of the cylinder, the tips of the paddles having a moderate clearance with the screen. These paddles act as openers and beaters to break up wads of seed cotton into locks and agitate the cotton as it travels through the cylinder to the outlet.

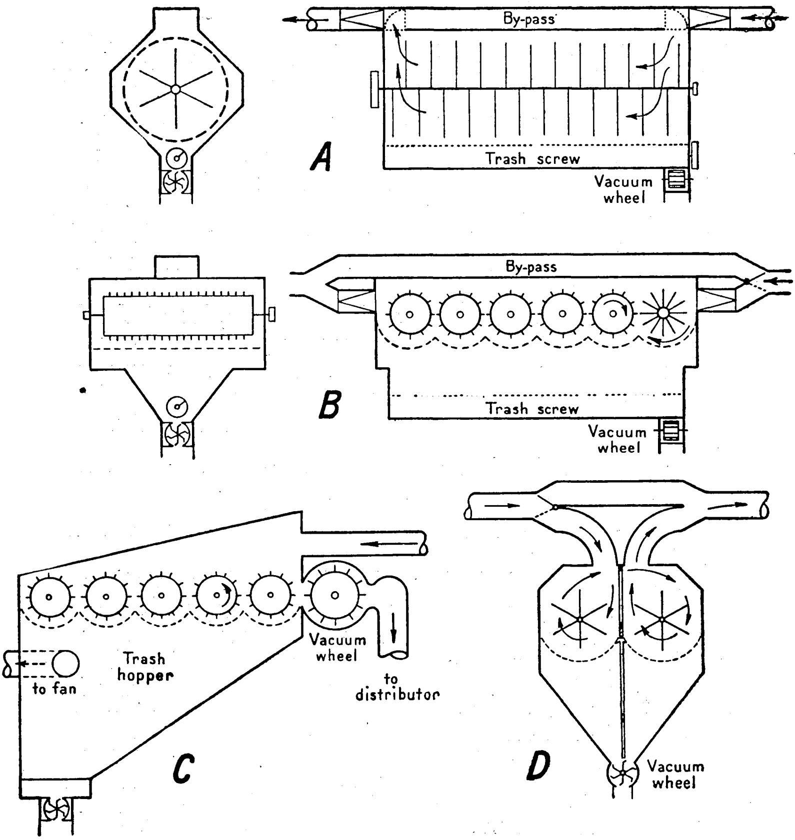


FIGURE 8.—Common forms of air-line cleaners.

Cross-drum types of air-line cleaners (fig. 8, *B* and *C*) are provided with conventional spiked-drum or spider-arm cylinders whose shafts are at right angles to the direction of the air and cotton flow, and with screens scalloped to the curve of the cylinders for separating the foreign matter from the traveling bat of cotton. In the cleaner shown in figure 8, *C*, the seed cotton is conveyed over the top of the cylinders to the rear of the cleaner and thence is propelled forward between the cylinders and the screening surface to a plain separator wheel with rubber tips which acts as the air seal for the cleaner casing. The trash is sucked through the screen and discharged through a sealed

wheel at the bottom of the hopper, the fan connection being on one side of the hopper beneath the screen.

A more recent type of air-line cleaner (fig. 8, *D*) combines certain features of previous designs, but introduces a distinctive serpentine division of the seed cotton into right- and left-hand paths of travel which unite at the discharge. Two straight-flow beater shafts are used, each having right-hand and left-hand paddles.

Foreign matter removed by the axial-flow air-line cleaner and by he cross-drum air-line cleaner is shown in figure 9. It is to be noted

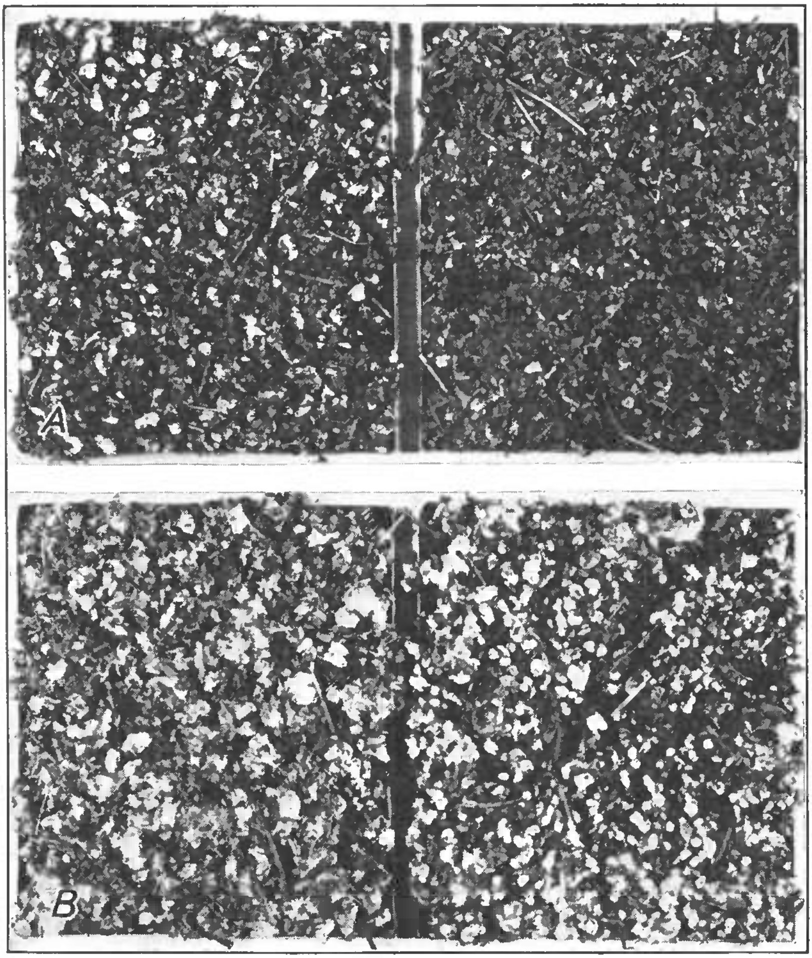


FIGURE 9.—Trash removed by air-line cleaners: *A*, By an axial-flow cleaner; *B*, by a cross-drum cleaner.

that the cross-drum type removed more motes than did the other. As compared with a separator set-up, air-line cleaners generally show some advantage in the grade of the lint, both with trashy and with fairly clean hand-picked cotton, even when a big-drum or a multi-drum cleaning feeder is used with a huller gin. Of course they show more benefits to grade when the feeders are of a simpler design that

does little or no cleaning, and when the gins are of a plain single-rib type that extracts little or no foreign matter.

OUT-OF-AIR CLEANERS

The increasing number of gins that use the mechanical system of feeding has led to much more extensive use of out-of-air cleaners than of air-line cleaners, although the latter are suitable for use also in mechanical systems. For mechanical systems, the number of cleaning cylinders may vary from 3 to 40 or more; and the construction features of the cylinders may differ widely. The three conventional forms of cleaning cylinders used in out-of-air cleaners are the spiked drum, the paddle wheel, and the spider arm, as shown in figure 10.

In spiked-drum cylinders the drum is commonly 12 inches in diameter and approximately 4 feet long. The spikes, which protrude from 1 to 2 inches, are made of ⅜- or ½-inch-diameter steel rod bent to the

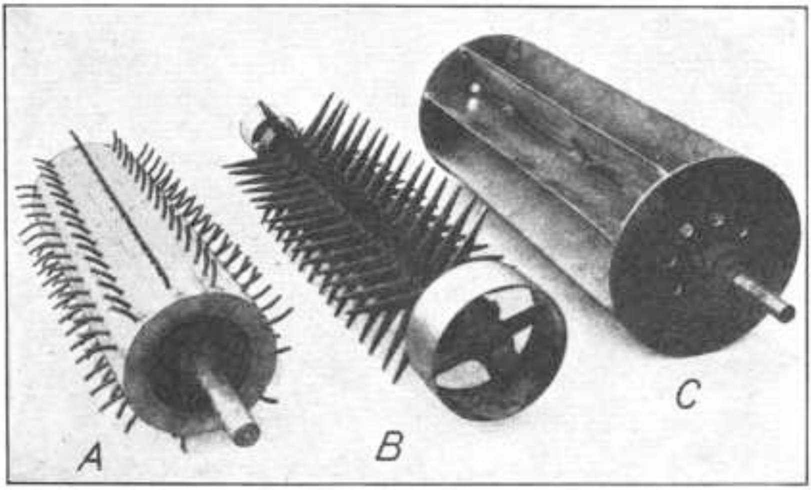


FIGURE 10.—Conventional cleaning cylinders: *A*, Spiked drum; *B*, spider arm; *C*, paddle wheel.

desired shape and rounded off to prevent damage to the cotton. The cylinder may be of either wood or metal construction, properly banded to stand up under normal speeds.

Spider-arm cylinders ordinarily have six rows of heavy, tapering spokes, somewhat similar to a rimless wheel, with the ends of the spokes well rounded. This type of cylinder may be so driven as to give a boll-breaking action, and is often used as an advance or leading cylinder in a series composed otherwise of other-type cylinders to break bolls and thus eliminate crushers which otherwise would be necessary.

Paddle-wheel cylinders may have either 5 or 6 blades, with or without a central core. The 5-blade cylinders usually have short blades upon a pentagonal core, but 6-blade cylinders are being used with disk ends and a plain shaft at the center.

In many areas where rough harvesting does not prevail, except perhaps on the last picking, or what is termed "scrapping", cleaners having 4 to 6 cylinders are used to advantage when adequate cleaning

cannot be accomplished by extractors, feeders, and huller fronts. Tests with double-rib huller gins have shown that when big-drum cleaning feeders or unit extractors are used on hand-picked cotton, 4-cylinder cleaners give only slight additional grade benefits.

Spider-arm cleaners expel more motes and stems than spiked-drum cleaners, as is shown by figure 11.

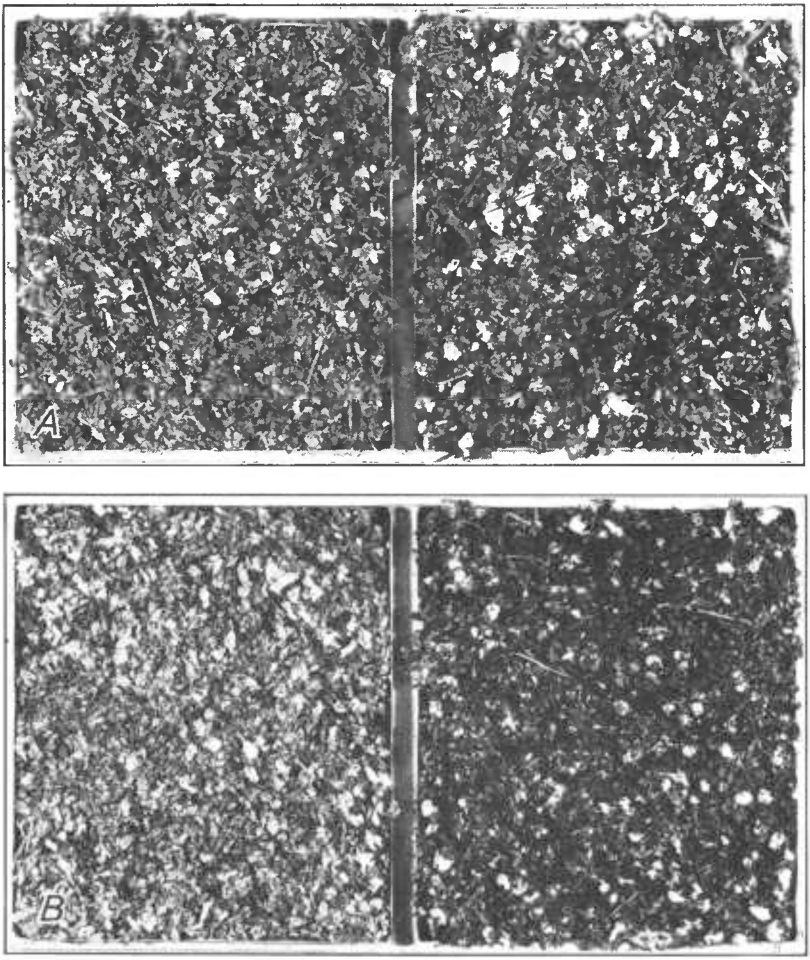


FIGURE 11.—Typical samples of trash removed from four different seed cottons: *A*, By a spider-arm cleaner; *B*, by a spiked-drum cleaner.

Practically all cylinder cleaners, including air-line types, operate at speeds ranging from 300 to 600 revolutions per minute, and an improved practice is to limit the number of cleaning cylinders so that the largest part of the removal of foreign matter can be done by extractors. To this end, on rough cottons it is considered to be good practice to use machinery combinations that include cleaning cylinders, then an extractor, and finally a finishing set of cleaning cylinders.

EXTRACTORS

Extracting differs widely from cleaning because it holds locks of seed cotton on the teeth of circular saws, cylinders, or belts while subjecting the locks to carding and beating action for removing foreign matter. The pitch or forward slope of these teeth is very important in the carding operation, because the teeth must release the locks of cotton without doing any ginning. In many simple

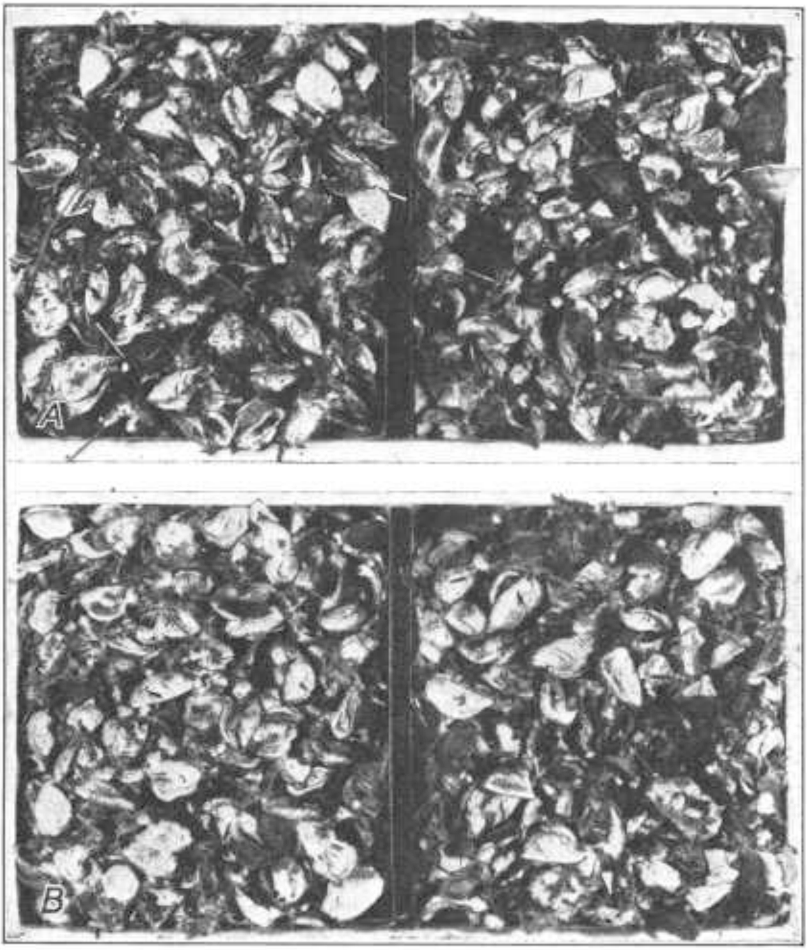


FIGURE 12.—Trash removed by unit extractors: *A*, By multi-saw extractors; *B*, by single-saw extractor.

ginning plants the fronts of huller gins perform all of the extracting that is done, but in areas where large quantities of coarse foreign matter are to be removed special extracting machines are necessary.

There are many designs of master and unit extractors on the market. Cleaning screens and cleaning cylinders can be incorporated in these machines, so that the seed cotton can be subjected to a cleaning action before or after extracting, or both. Foreign matter removed by two types of unit extractors is shown in figure 12. More

burs and stems were usually removed by the multi-saw unit than by the single-saw unit. For this reason the grade of lint from the former may be expected to be the better.

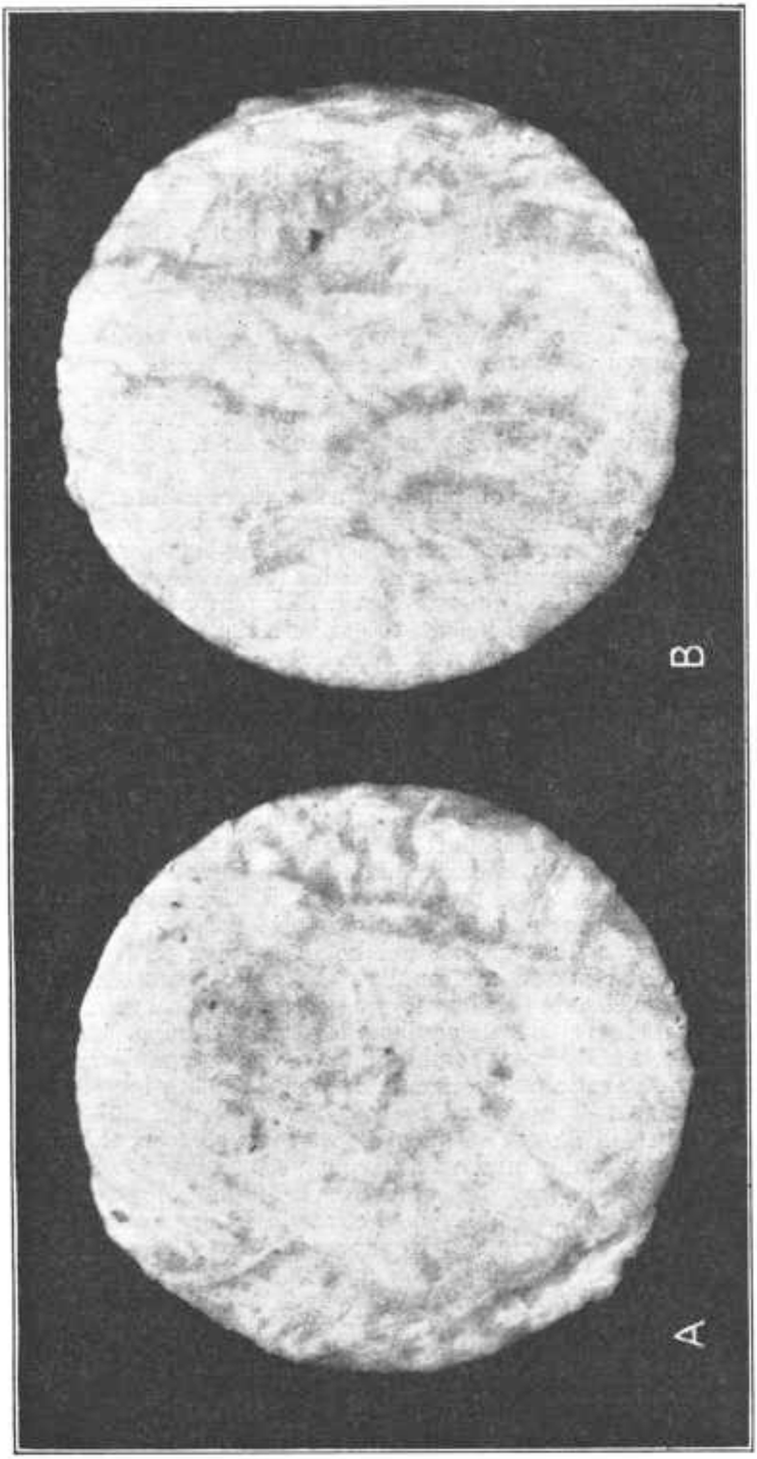
Unit extractors instead of feeders are used more extensively than master extractors, and have proved to be valuable additions to gin plants even in areas where rough harvesting is not practiced. Experiments conducted at the ginning and fiber laboratories of the Department of Agriculture show that on fairly clean picked cotton improved designs of unit extractors give improvements in grade equal to, and sometimes better than, the best air-line cleaners and that on roughly gathered cotton they give considerably greater improvements in grade.

These tests have also shown that, when air-line cleaners and unit extractors are used together, there are sometimes still greater benefits from a grade standpoint because of the greater quantity of trash removed. However, limit of cleaning usually was reached with these machines, and the addition of a 4-cylinder cleaner did not improve the grade.

The benefits in grade obtained by using these units separately and in combination are illustrated in figures 13 and 14 for short-staple and long-staple cottons, respectively. The samples shown were ginned on a double-rib huller air-blast gin, with a loose seed roll and a normal or manufacturer's rated gin-saw speed. Evidently the addition of the extractor units was very helpful to grade in the case of both cottons. The staple length of these cottons was not generally affected by using cleaners and extractors. But if damp or wet long-staple cottons had been subjected to all of the units indicated, or to a greater number of units than were required for adequate cleaning, it is possible that the quality of the resulting ginned lint would have been injured. Excessive handling causes roping of the locks of such cotton, and when the saws strike these ropes damage is likely to be done.

In the light of these facts it is desirable that both cotton farmers and ginners should be well acquainted with cleaning and extracting processes, so that a good machinery combination may be chosen for handling the seed cotton satisfactorily in each locality. The operating costs and ginning charges should be in keeping with the class of service required in the community. In some parts of the Cotton Belt extensive cleaning and extracting equipment is a vital necessity; in other parts less elaborate equipment may be enough.

Some effects of different combinations of cleaning and/or extracting equipment on grade of lint from Mississippi Delta long-staple and west Texas short-staple seed cottons harvested by different methods are shown in figures 15 and 16. As may be seen, the elaborate processes of cleaning and extracting failed to bring about in the roughly harvested cotton lint of as high a grade as the simplest processes produced in the hand-picked cotton. In most cases the difference was about a full grade. But some improvements in grade were caused by the use of these machinery combinations. In the roughly harvested cotton from Texas there was a favorable effect on grade with each addition of cleaning and extracting units. In the Mississippi hand-picked and hand-snapped cottons also there was a tendency for the grade to improve as additional cleaning and extracting units were used.


B
A

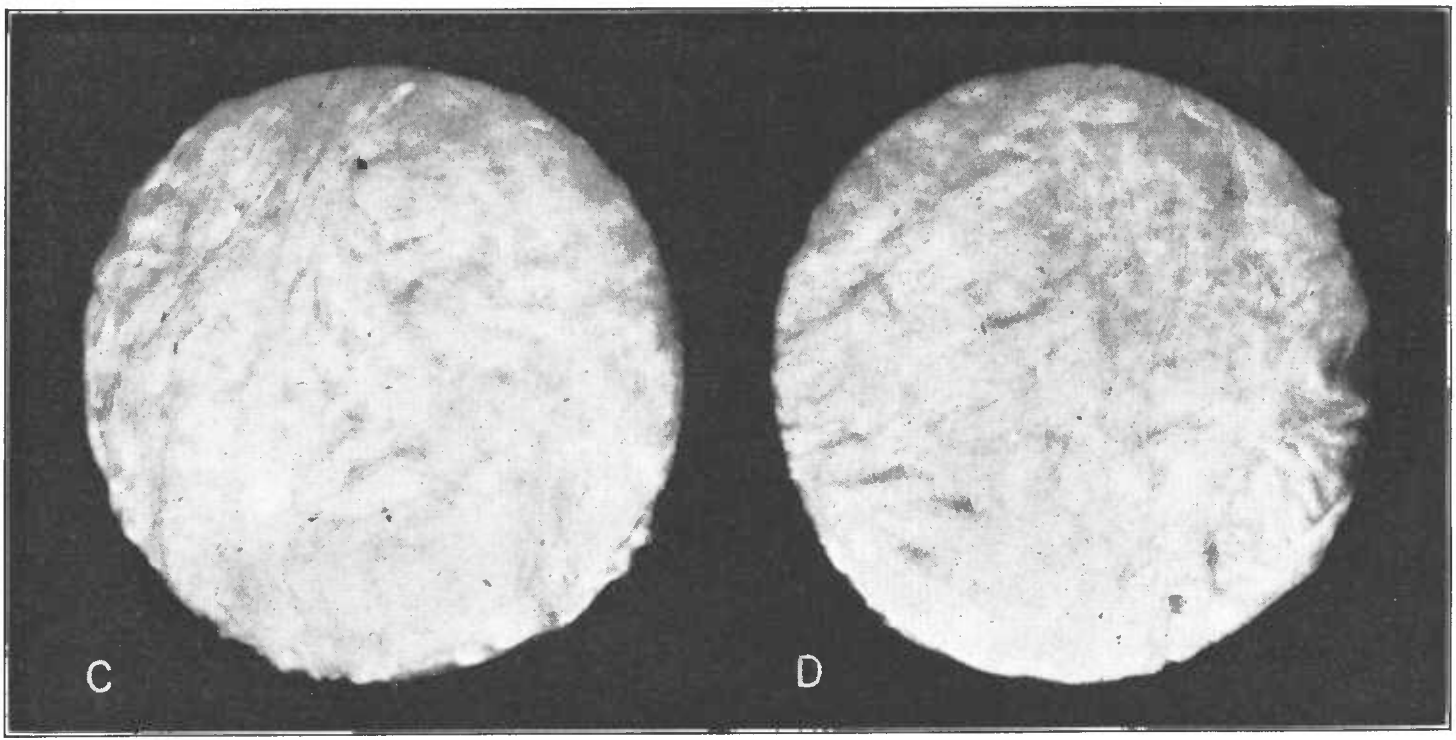
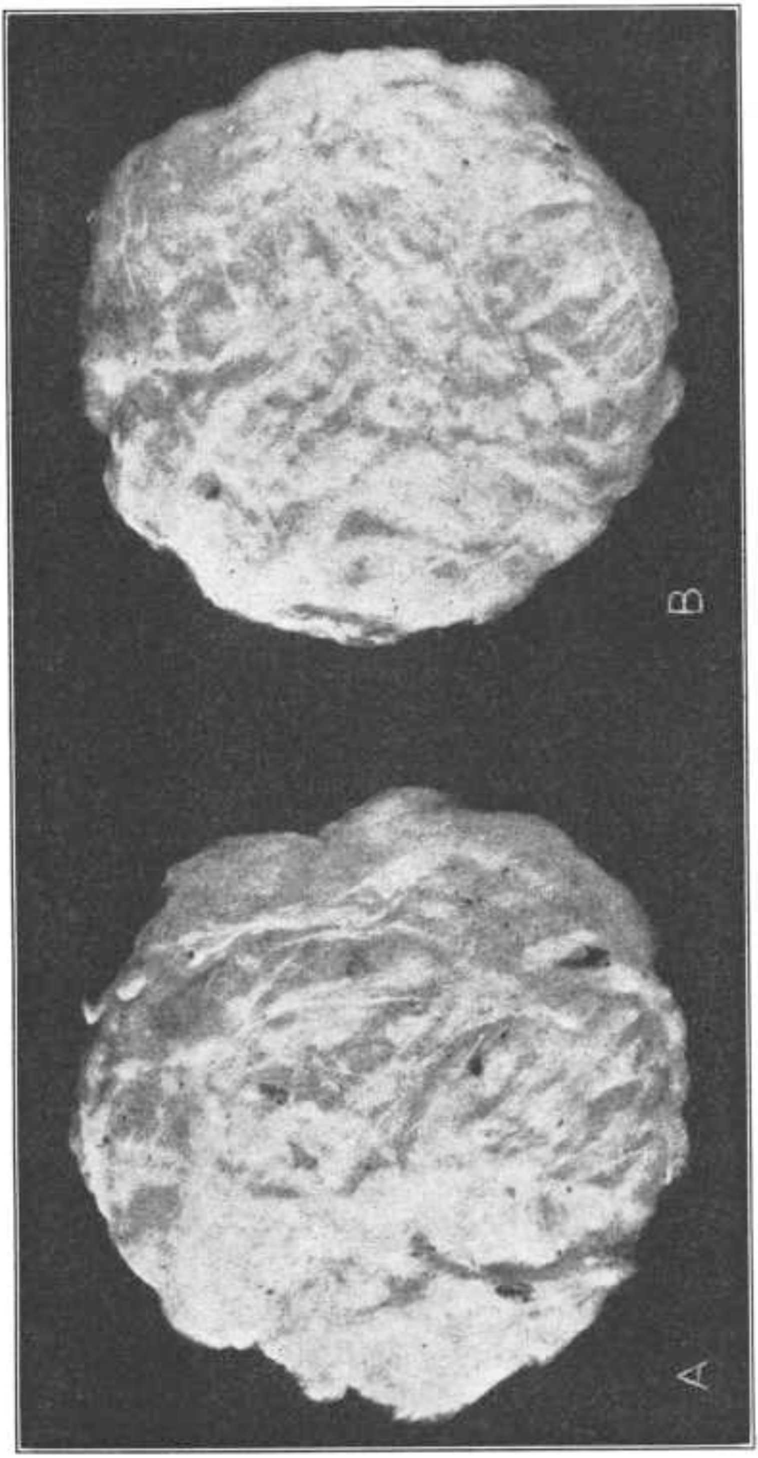


FIGURE 13.—Lint ginned from short-staple seed cotton cleaned by different processes: *A*, By revolving-screen separator only; *B*, by 6-cylinder air-line cleaner and revolving-screen separator; *C*, by revolving-screen separator and unit cleaner-extractor-feeder; *D*, by 6-cylinder air-line cleaner, revolving-screen separator, and unit cleaner-extractor-feeder.


B
A

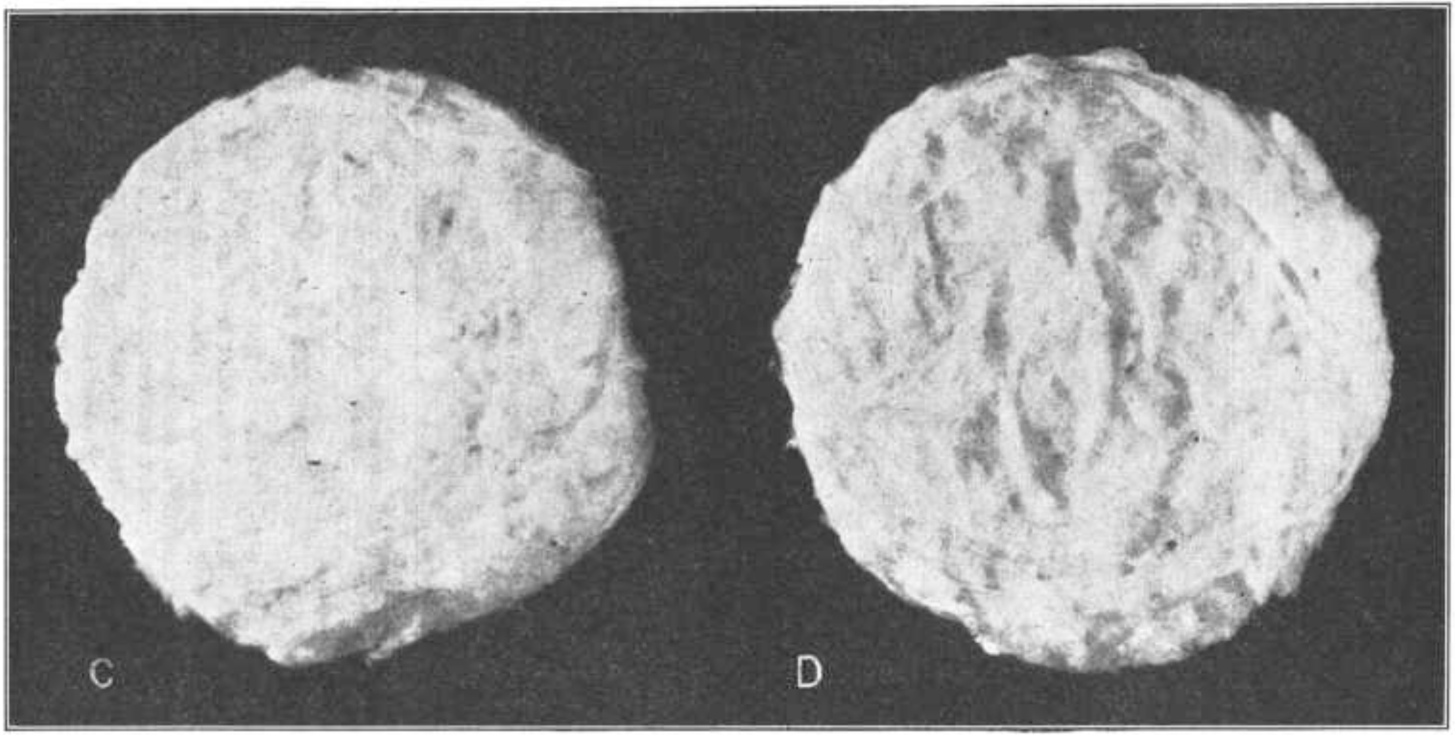


FIGURE 14.—Lint ginned from long-staple seed cotton cleaned by different processes: *A*, By cleaner-separator only; *B*, by 6-cylinder air-line cleaner and cleaner-separator; *C*, by cleaner-separator and unit cleaner-extractor-feeder; *D*, by 6-cylinder air-line cleaner, cleaner-separator, and unit cleaner-extractor-feeder.

These and other tests conducted by the Department of Agriculture emphasize how desirable it is that the farmer use care in harvesting his cotton crop, even though present-day gin machinery is fairly effective in cleaning dirty, trashy, or roughly harvested cotton. Complaints of cotton spinners suggest that excessive use of cleaning and extracting machinery may seriously damage other elements of lint quality than grade.

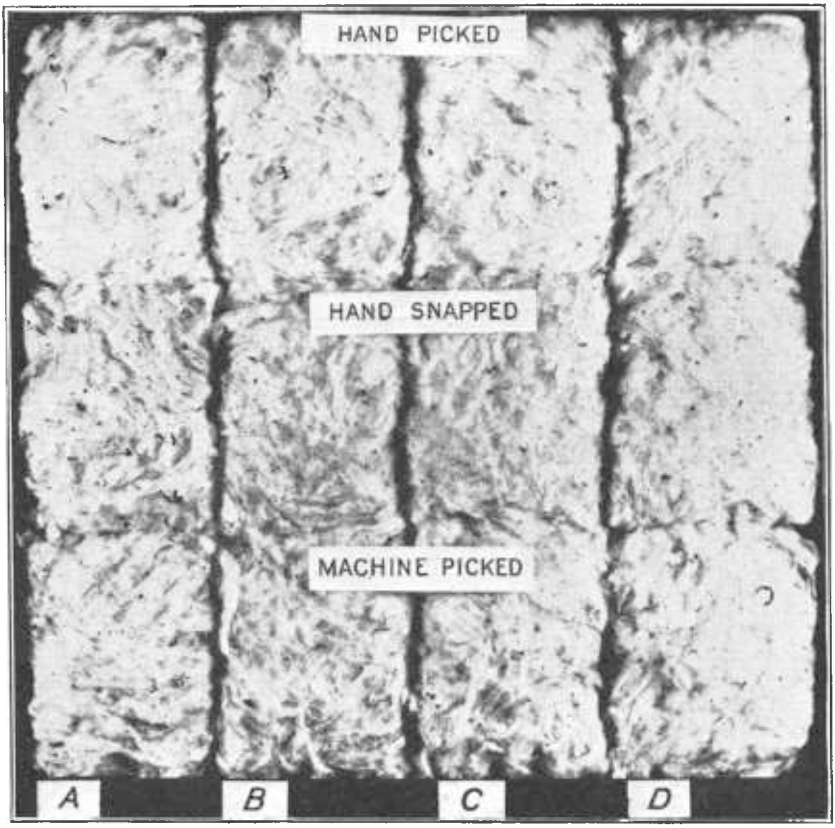


FIGURE 15.—Lint ginned from Mississippi long-staple seed cotton variously harvested, cleaned by different processes: *A*, By revolving-screen separator only; *B*, by revolving-screen separator and 4-cylinder spider-arm cleaner; *C*, by 6-cylinder air-line cleaner, revolving-screen separator, and 4-cylinder spider-arm cleaner; *D*, by 6-cylinder air-line cleaner, revolving-screen separator, 4-cylinder spider-arm cleaner, and unit cleaner-extractor-feeder.

FEEDERS

Feeders were first used to control the feeding of seed cotton into the gin stands. At first the front feeder was used (fig. 17). With this type of feeder the wagons of seed cotton could be driven into the gin plant and unloaded directly into the feeder boxes by means of baskets or forks. Later a flat feeder was developed (fig. 18), which is still used in some sections. This form brought with it various methods of regulating the rate of feeding, and cleaning cylinders and screens were finally provided in it. These cleaning cylinders were about 12 inches in diameter, were constructed of wood, and had rows of round-ended spikes about 1 inch long. This type was the first attempt to

extend the function of feeders to doing some cleaning of the seed cotton, but much fine dirt and dust was shaken out through the slats of the flat feeder belts.

What is now known as the small-drum cleaning feeder was developed from the improved flat feeder, because the vertical form was found to be more adaptable than the horizontal for connecting with pneumatic chutes and belt distributors. However, the size and construction of the cleaning cylinder was retained in the small-drum feeder. Figures 19 and 20 show small-drum feeders installed on cotton gins equipped with different systems of feeding.

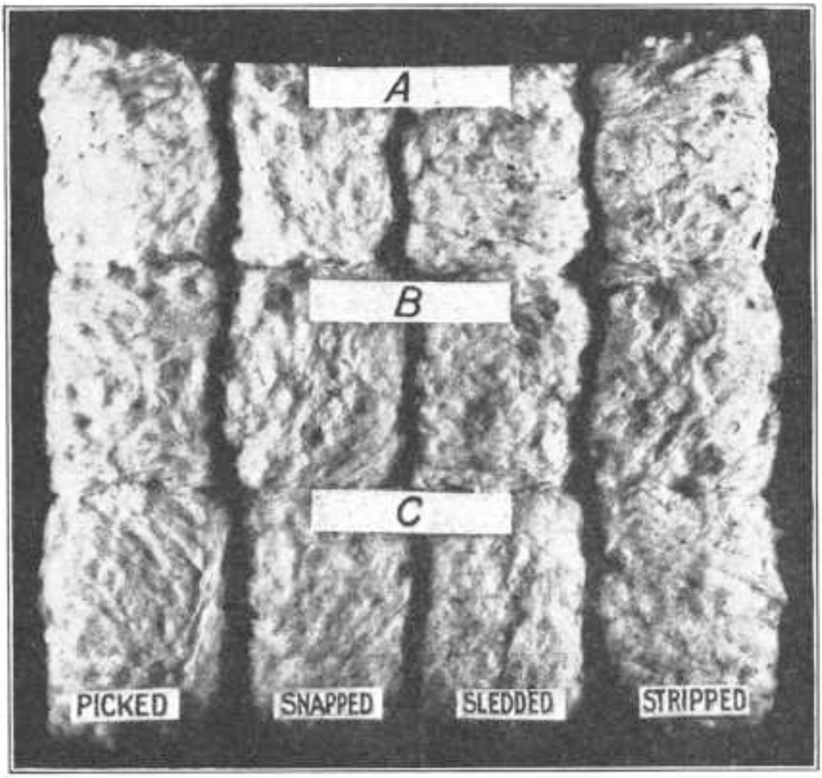


FIGURE 16.—Lint ginned from Texas short-staple seed cotton, variously harvested, cleaned by different methods: *A*, By revolving-screen separator and 4-cylinder spider-arm cleaner; *B*, by 6-cylinder air-line cleaner, revolving-screen separator, and 4-cylinder spider-arm cleaner; *C*, by 6-cylinder air-line cleaner, revolving-screen separator, 4-cylinder spider-arm cleaner, and unit extractor.

Later enlargement of drums and cleaning surfaces was a natural outgrowth of better manufacturing and standardization methods, and provision for more cleaning at this stage in the ginning process resulted in present-day units known as big-drum cleaning feeders. Instead of these big-drum feeders some gins use certain kinds of multidrum feeders having equivalent cleaning capacity. The screening surfaces and cleaning effects of both big-drum and multidrum cleaning feeders are superior to those of the small-drum feeders.

Tests at the Department's cotton ginning and fiber laboratories show that, with hand-picked cotton, when big-drum cleaning feeders

or overhead master cleaners are not overloaded the cleaning effects are nearly identical.

Cotton gins in some sections encounter a great deal of very roughly harvested cotton. The ginner may make use of either master or unit extractors in handling such cottons. Using unit extractor-feeders rather than big-drum cleaning feeders is permissible because they

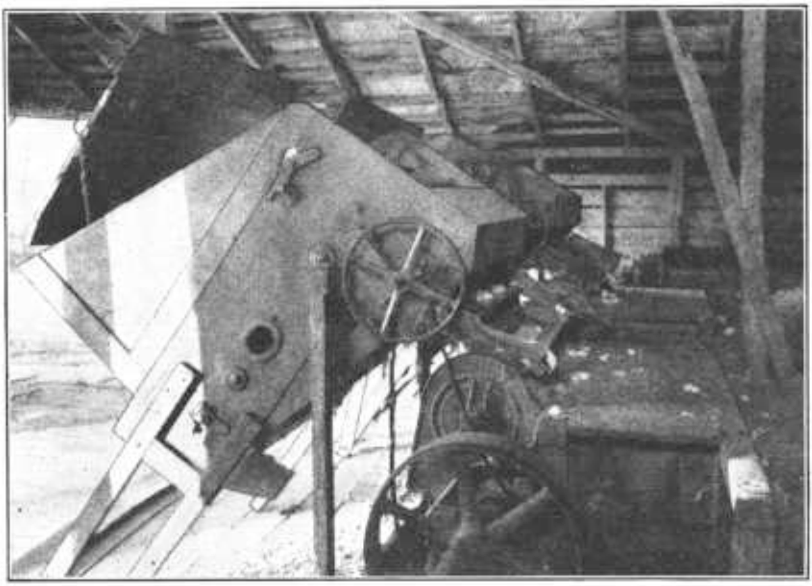


FIGURE 17.—Front feeders on gin stands.

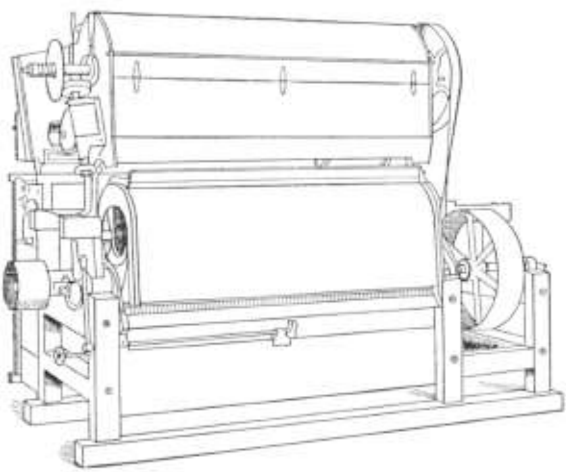


FIGURE 18.—Plain flat feeder on gin stand.

accomplish cleaning as well as extracting; so in selecting the feeders for his gin stands, the ginner has a number of well-balanced machinery combinations from which to choose.

Feeders, like cleaners and extractors, require inspection and good maintenance of their screens and cylinders.

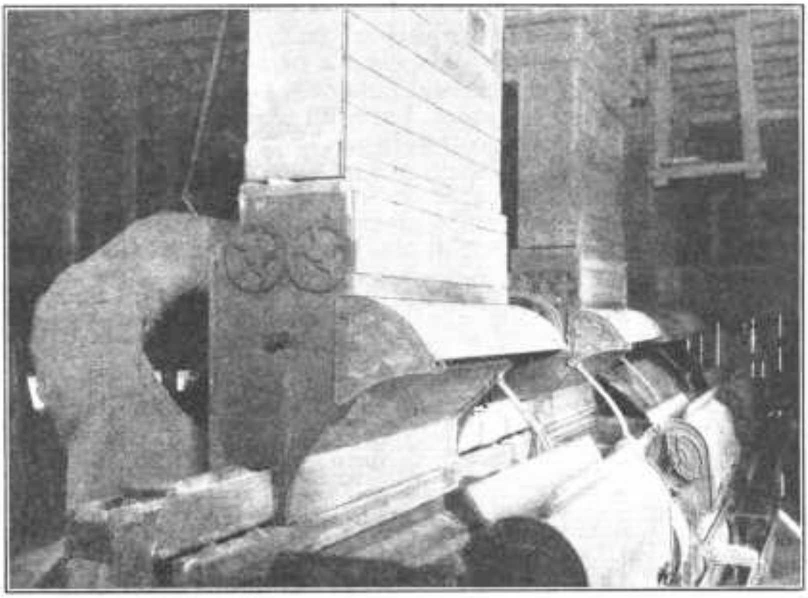


FIGURE 19.—Small-drum cleaning feeders, with pneumatic distribution system.

FIGURE 20.—Small-drum cleaning feeders, with mechanical or belt distribution system.

GIN STANDS

TYPES OF GINS

Two principal types of saw gins are in use today—air blast and brush. Each type includes plain designs in which the seed cotton is fed directly into the roll box, and huller designs in which it is fed to picker rollers designed to extract burs and trash. In the huller gins, the gin saws draw the seed cotton from the picker roller of the huller breast through the huller ribs into the roll box. Figure 21 shows cross sections of four plain and huller gin fronts.

The double-rib huller fronts predominate. The protection they give to the gin saws and their elimination of foreign matter like burs,

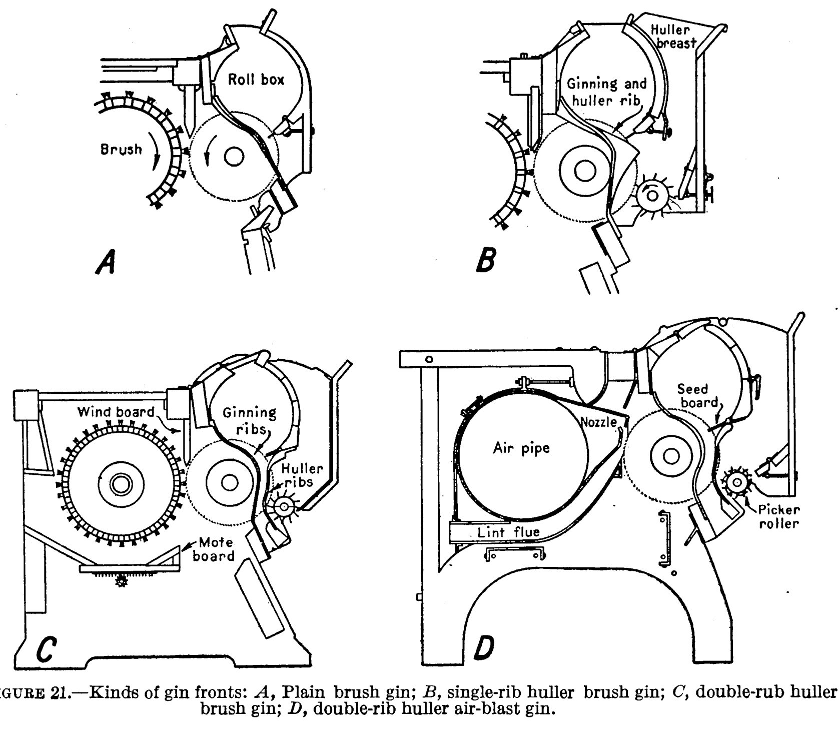


FIGURE 21.—Kinds of gin fronts: *A*, Plain brush gin; *B*, single-rib huller brush gin; *C*, double-rub huller brush gin; *D*, double-rib huller air-blast gin.

hulls, and leaf stems have made them very popular. In only the Southeastern States are the single-rib plain gins now found to any extent. It is important to keep foreign matter from the seed roll so that the ginned lint will not be contaminated as is likely to happen when the gin saws have to cut through a trash-laden seed roll in the ginning breast or roll box.

If rough trashy cotton like that harvested late in the season must be ginned, a huller gin will give the best results when the picker roller is set as far away from the huller ribs as possible. This adjustment allows a free discharge of foreign matter. If the trash does not discharge readily from the huller front, the gin saws drag in parts of it, the ginning capacity is reduced, chokages follow, and a poor grade of lint is turned out. Then the part of the trash drawn into the roll box that does not go with the lint is discharged with the seed and lowers its value.

With a plain gin it is usually advisable to install a master extractor or a unit extractor-feeder if trashy cotton is to be ginned.

The gins shown in figure 21 are all of the type which "mote by gravity"; that is, they cast off motes and some foreign matter into the spaces below the saws. Other efficient and economical designs of gins mote by centrifugal force, discharging the motes overhead between the back of the ribs and the brush or the air-blast nozzle.

RATE OF FEEDING

The rate at which seed cotton is fed to the gin saws has an important influence on the quality of the lint produced. The cotton farmer pays dearly when he insists on crowding his cotton through the gin. Both the air-blast and brush gins give a smoother and more valuable sample when the gin stands are fed so as to obtain a loose seed roll. The rate at which the seed cotton should be fed to the gin saws depends on the amount of moisture in the seed cotton, the length of the staple, the size and fuzziness of the seed, and other physical characteristics of the cotton. Long-staple cotton should be fed and ginned more slowly than short-staple cotton, and green or damp cotton more slowly than dry cotton. A loose seed roll produces a smoother sample than a tight seed roll. A ginner who is feeding the gin stands at the lowest rate and still getting a rough sample can often improve it by slowing down his feeder drive. Setting the seed board wide open also helps because it permits a good discharge of seed and thus contributes to a loose seed roll.

SEED-ROLL DENSITY

Samples ginned with a loose seed roll average from one-third to almost a full grade better than those ginned in the same way except with a tight roll, depending on the staple length and the moisture of the cotton. On some individual cottons the resulting lint is sometimes two full grades better. Using a tight seed roll not only lowers ginning preparation, 1 of the 3 factors of grade, but also affects the observed color and leaf, the other 2 factors of grade. Fast ginning therefore should be avoided.

With the same group of cottons of 1⅛ inches and greater length discussed on page 9, the benefits of using a loose seed roll instead of a tight seed roll averaged approximately $4 per bale for those of 12-percent and greater moisture content, and averaged slightly more than $1 per bale for those of less than 12-percent moisture content. With the cottons of less than 1⅛ inches length, the average advantage of the loose seed roll was about $1 per bale for each moisture group.

The advantages of loose-roll ginning combined with seed-cotton drying are worth considering. With the longer cottons having a moisture content of 12 percent or more, drying the seed cotton and ginning with a loose seed roll yielded a much better lint than was obtained by ginning the same cotton without drying and with a tight seed roll. With the former method the lint averaged more than $7 per bale, or nearly 20 percent, more than the other lint. With the shorter cottons, similar difference in treatment yielded an average difference of almost $1.50 per bale, or about 4 percent, in the market value of the lint.

Illustrations of the superiority of loose-seed-roll samples over tight-seed-roll samples are shown in figures 22 to 27, for short-staple and long-staple cottons. Note the very nappy and rough preparation of

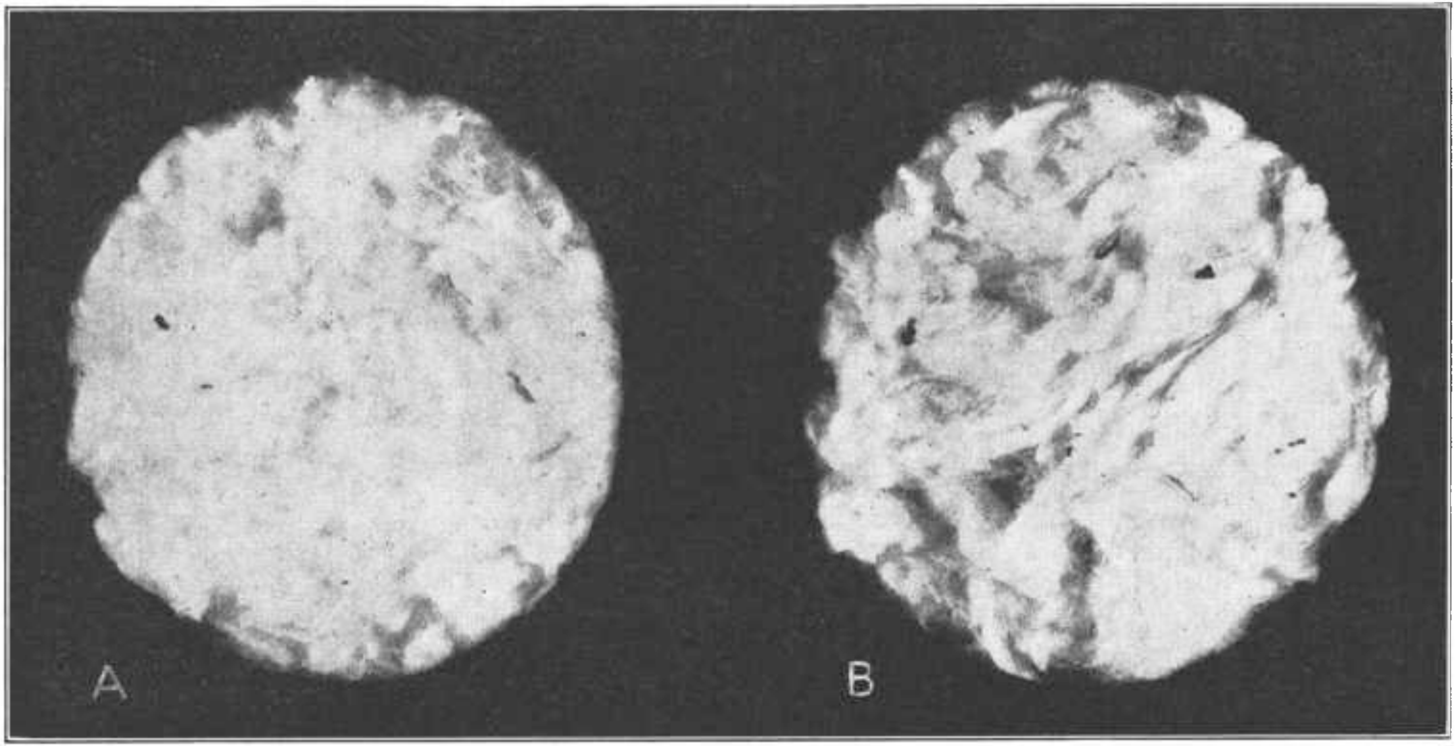


FIGURE 22.—Lint samples of short-staple cotton ginned at a saw speed of 400 revolutions per minute: *A*, With loose seed roll; *B*, with tight seed roll.

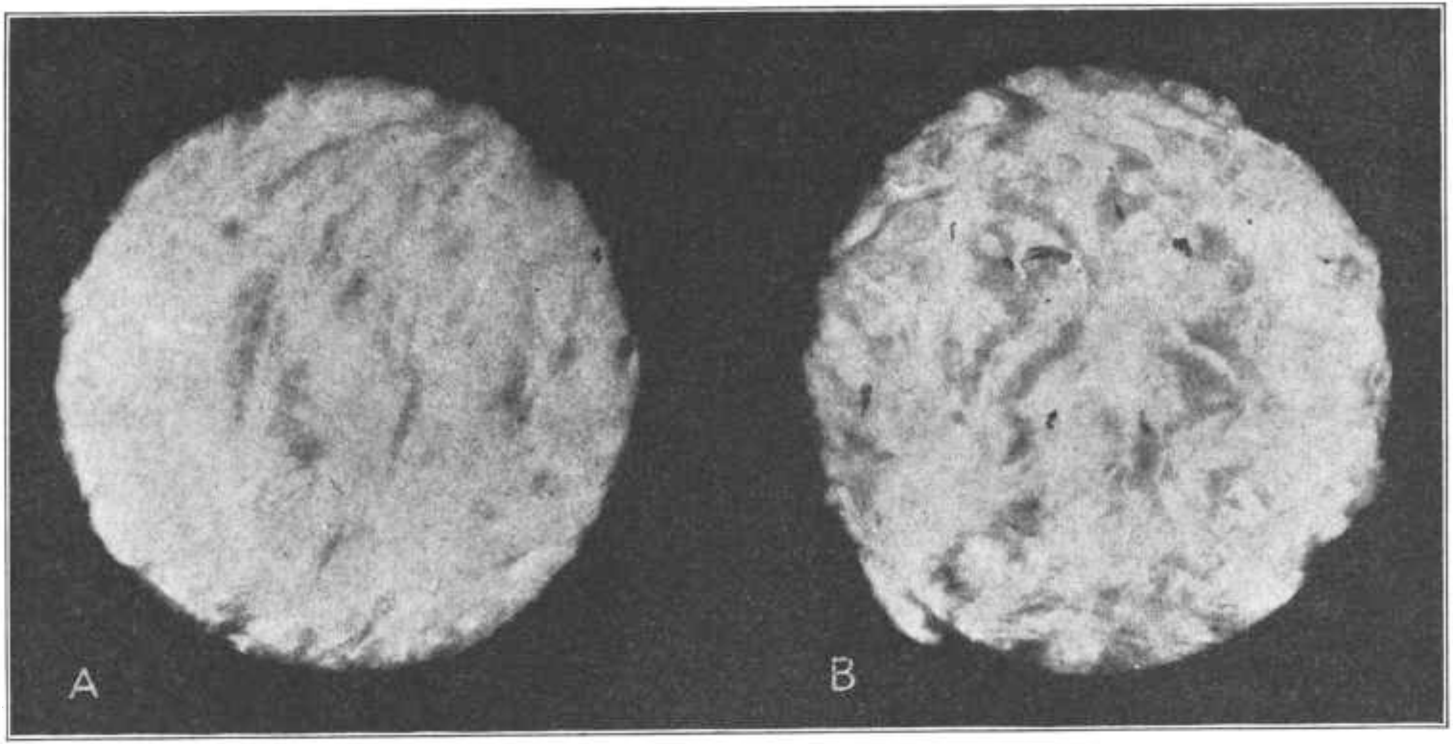


FIGURE 23.—Lint samples of short-staple cotton ginned at a saw speed of 500 revolutions per minute: *A*, With loose seed roll; *B*, with tight seed roll.

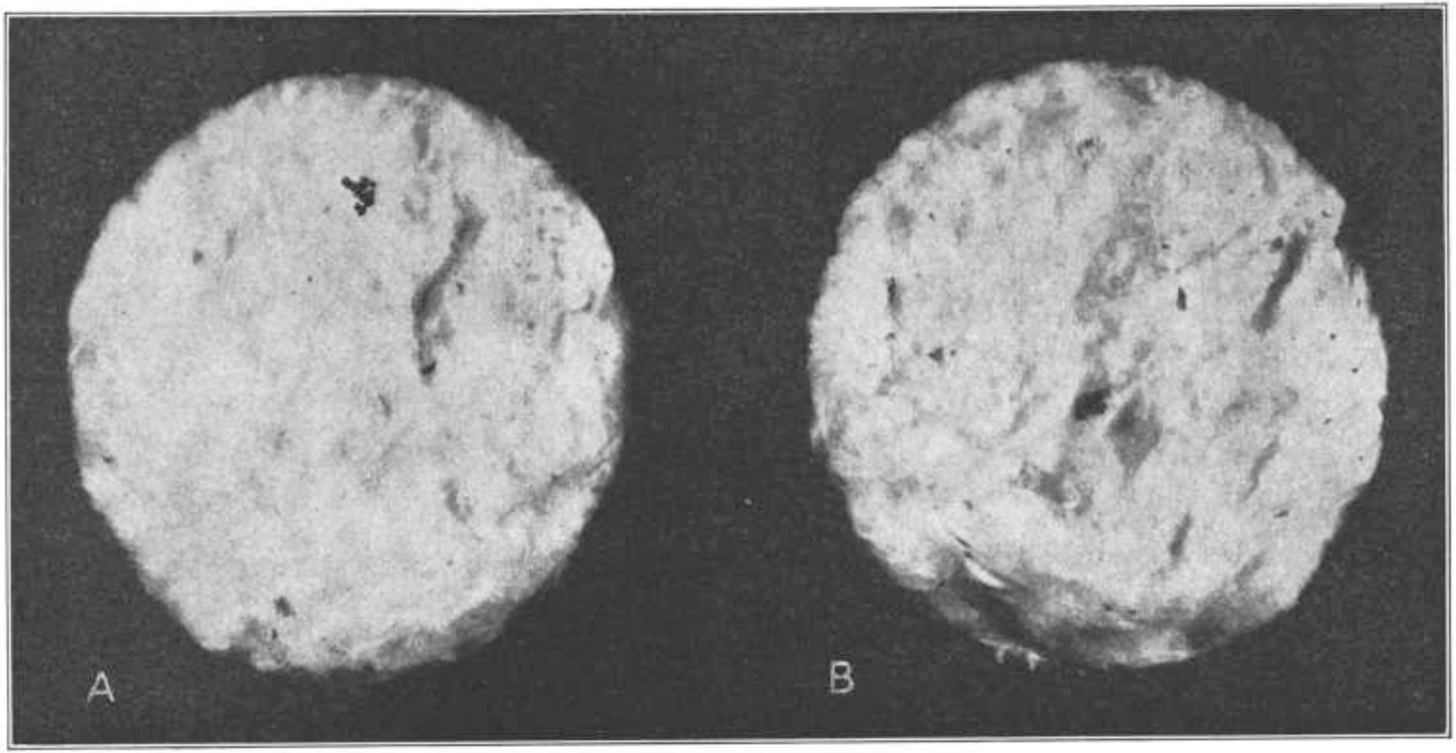


FIGURE 24.—Lint samples of short-staple cotton ginned at a saw speed of 600 revolutions per minute: *A*, With loose seed roll; *B*, with tight seed roll.

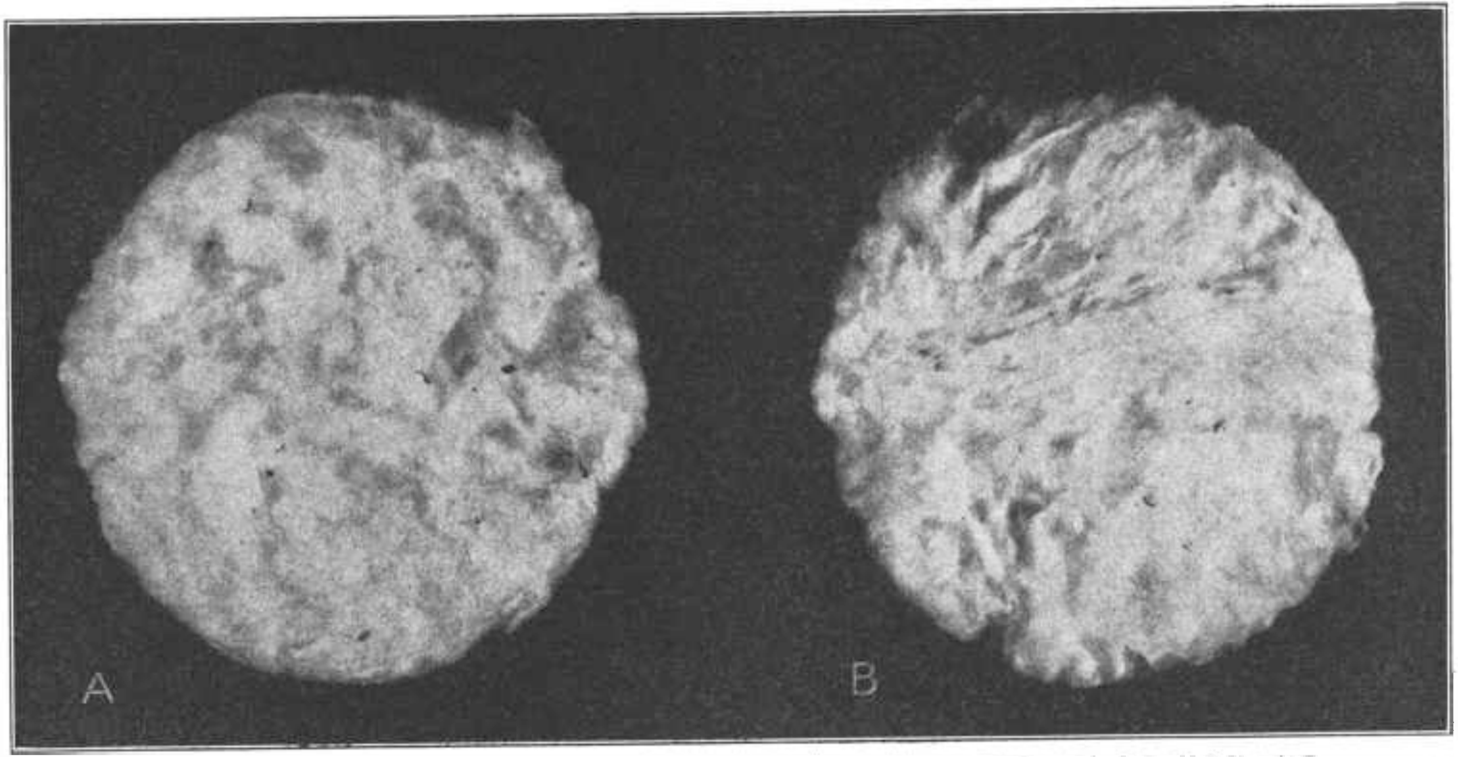


FIGURE 25.—Lint samples of long-staple cotton ginned at a saw speed of 400 revolutions per minute. *A*, With loose seed roll; *B*, with tight seed roll.

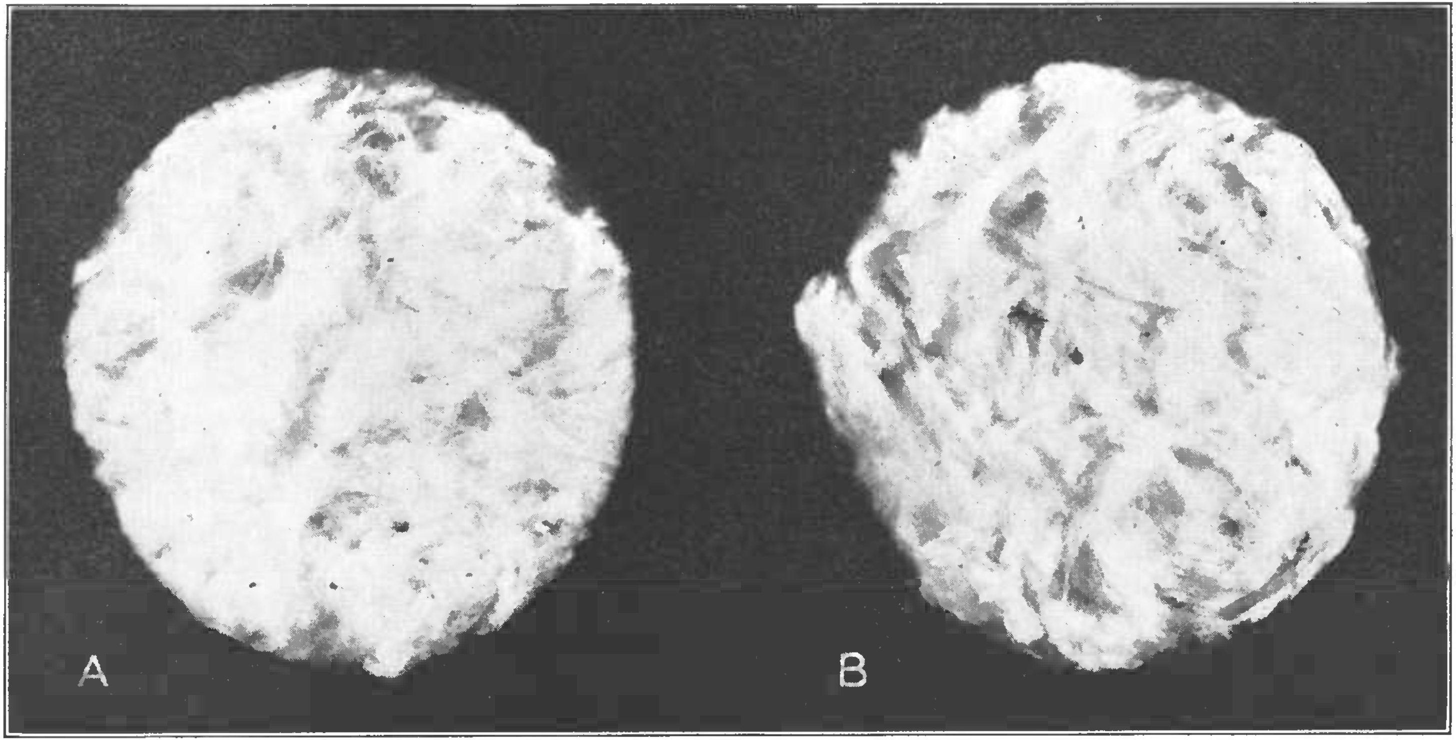


FIGURE 26.—Lint samples of long-staple cotton ginned at a saw speed of 500 revolutions per minute: *A*, With loose seed roll; *B*, with tight seed roll.

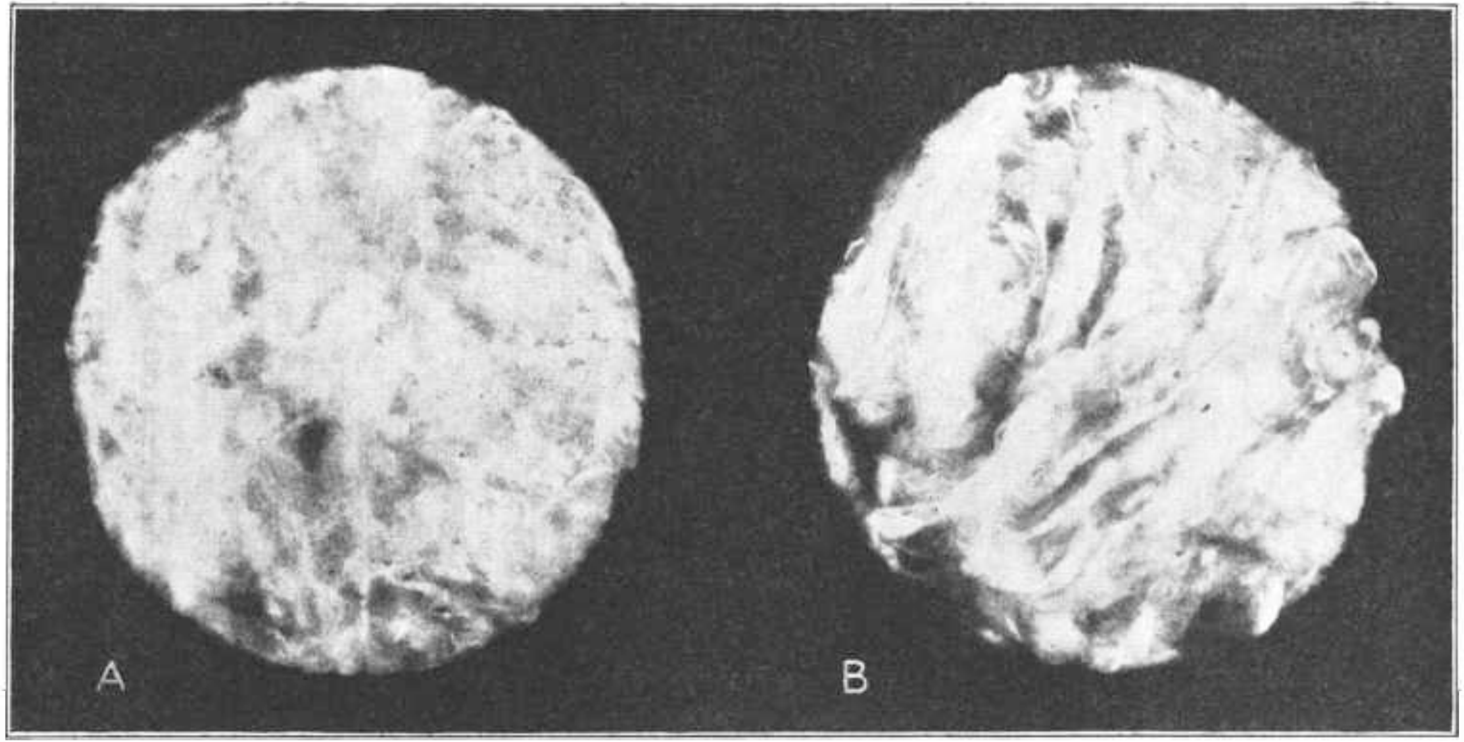


FIGURE 27.—Lint samples of long-staple cotton ginned at a saw speed of 600 revolutions per minute: A, With loose seed roll; B, with tight seed roll.

the tight-seed-roll samples on the right as compared with the loose-seed-roll samples on the left.

Using a loose seed roll has several advantages from a mechanical point of view. The loose seed roll requires less power, causes less wear and tear on gin saws and ribs, and causes less chokages in huller fronts, ribs, etc.

GIN-SAW SPEED

Gin-saw speed is secondary to roll density in its effects on the quality of lint (figs. 22 to 27). Present-day gins are designed to permit a certain amount of flexibility in saw speeds without causing much change in lint quality or mechanical operation. It appears to be generally advisable to follow the manufacturer's recommended speeds, although departures up to 100 revolutions per minute from these speeds have not thus far shown any appreciable effect on the quality or quantity of the lint. Within this range the small effects produced by changes from the manufacturers' speeds indicate a tendency for grade of lint to decline and outturn of lint to increase with advance in saw speed. Excessive speeds should be avoided for the sake of both the cotton and the machinery.

MOTE-BOARD ADJUSTMENT

The mote board should be so adjusted that the undesirable substances commonly known as motes can be readily expelled from the lint without loss of good fibers. It is good practice to observe the moting action of the gin and keep the mote board set to suit the cotton as the season progresses, checking adjustments by examining the press sample for motes and by observing the material cast off at the moting position.

The construction and the means for adjusting mote boards are varied, depending on the type and make of the gin stand. Brush gins are usually provided with movable mote boards placed below the brush in a horizontal or inclined position to form an extension to the bottom of the lint-flue connection. Air-blast gins usually have the equivalent of mote boards in the lower lip of the lint flue, which is located a few inches below the air-blast nozzle. Gins that mote by centrifugal force do not have mote boards, but may have adjustable devices of various kinds so that the moting can be somewhat regulated mechanically.

FANS AND COTTON PIPING

The fans used in cotton ginning are usually of the fully housed type, comprising a bladed wheel which revolves in a scroll or housing. These fans are designated by number (no. 30, no. 35, etc.). In a general way these numbers indicate the number of hundreds of cubic feet of air that the fan will handle per minute. Thus a no. 30 fan will normally deliver about 3,000 cubic feet of air per minute at its rated speed, and a no. 45 will deliver 4,500 cubic feet of air per minute. Increasing the speed for any size increases its volume or its pressure or both.

Fan wheels that have no side plates or shrouds are called plain wheels (fig. 28, *A*). Fan wheels designed for greater efficiency or for special purposes are frequently provided with shrouds (fig. 28, *B*). Cotton should not be allowed to pass through fans with

plain or shrouded wheels. The fans are protected against such a possibility by the screens in the separators or pneumatic elevators. Some installations eliminate the separators or pneumatic elevators by making use of a Rembert wheel (fig. 28, *C*), in which the perforated steel disk fastened to the side of the wheel prevents the cotton from passing through the blades of the fan. This wheel is necessarily a few inches narrower than the other types, to give room for the cotton to pass.

Rembert-type fans are used to deliver seed cotton to storage bins and to feed seed cotton through cotton driers. The standard types of fans with plain or shrouded wheels are generally used in the ginning establishment for handling the cotton through the piping from the wagon telescope to the separator and for blowing ginned seed to storage spaces or railway cars. Standard fans also provide adequate volumes of air for air-blast gins.

In all fans used at cotton gins it is customary to employ sheet-metal cotton piping ranging from 9 to 16 inches in diameter, and to maintain an air velocity within such pipes of 2,500 to 4,500 linear feet per minute in order to handle seed cotton and ginned seed. As a result of such velocities the air pressures are high, and there is chance of inefficient and costly operation. Fans are frequently run

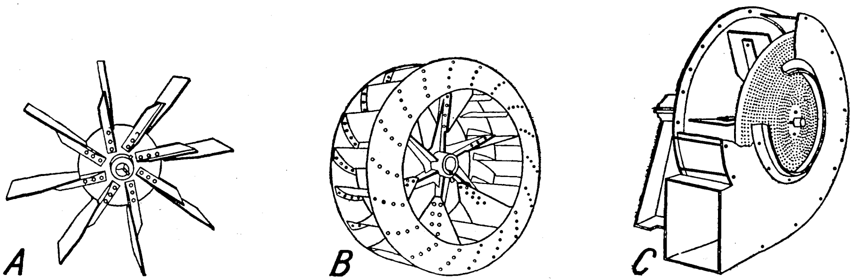


FIGURE 28.—Representative types of gin-fan wheels: *A*, Plain 8-blade wheel; *B*, shrouded 18-blade wheel; *C*, Rembert-type wheel, in fan casing.

at too high a speed, which tends to excessive power cost, or they are run at too great pressure. Many systems allow the fan to be heavily loaded at times when the cotton gins are idling. This is a costly and faulty practice, which is encountered even in some gins well operated in other respects.

High-efficiency fans of slow speed have greater diameters and narrower wheels than those ordinarily used by cotton ginners. Other improvements recommended are shrouded wheels having from 12 to 18 blades, universal housings that may be used either right hand or left hand and permit adjusting to 8 or more discharging positions, ball bearings, lower speed ratings, and especially lower power requirements. These add to the first cost of a fan, but they are well worth while because they reduce the power consumption and pay for the fan over a reasonable period of operation.

When a new ginning plant is to be built, it is advisable to specify the type and size of fans best suited to the particular work to be done, and when replacing a fan that is worn out or is using too much power an efficient type should be selected. The representatives of electric-light and power companies in most cotton-growing States have instruments for measuring fan speeds, volumes, and pressures.

After having learned these facts about the old unit, the right new one can be intelligently selected from the performance tables that most fan manufacturers will supply on request. These tables usually offer a rather wide range of selection in designs and performances.

In selecting Rembert-type fans, it is desirable to obtain oversize units in order to avoid excessive speeds. Thus a size 45 casing with a size 40 wheel and Rembert disk is more desirable than a size 40 casing with only a size 35 wheel and disk. The larger fan will ordinarily deliver air volumes approximately equal to the volumes of a size 35 standard fan; the smaller unit is about equal in delivery to a size 30 standard fan. Some manufacturers mark such fans 45–35 or 40–30 to designate this capacity limitation. Rembert-type fans can frequently be used for more than one purpose. For instance, one can be used during ginning as an unloader fan in connection with pneumatic elevators or a mechanical separator, and during other periods as a cotton-house loader,by using a valved by-pass pipe around the pneumatic elevator or separator. In cotton drying the Rembert fan is useful because it can be used without a separator and thus uses less power, or it can be combined with cotton-house loading so that it will not only serve for the drier but will also be available for delivering cotton to bins or transferring it from one bin to another.

The cotton piping in gins is usually constructed according to certain trade standards. Galvanized sheet metal of no. 22 gage is commonly used; joints are of the slip or stovepipe variety, secured tightly with bands that are drawn up with stove bolts; elbows are made in either 5- or 7-segment sections, depending on the diameter of pipe and radius of curvature; and adapter fittings are built up to make suitable junctions between fans, cotton piping, and other pieces of apparatus. Wagon telescopes are included in cotton-piping work, and can be provided with flexible canvas joints or patented socket joints of various forms. As a rule the telescopes are counterweighted so they will be approximately 7 feet above the wagon platform or runway when not in use.

PRESSING AND BALING

The ginned lint is blown from the gin saws to the lint flue by the air current created by the brushes of brush gins, or by the air from the blast fan of air-blast gins. The lint flue should be properly proportioned and should contain no obstructions such as rivet heads or rust to accumulate lint and dust, for such material when finally discharged detracts from the quality of the bale of cotton. The continuous current of air in the lint flue takes the lint to a condenser, which separates the lint from the air. The lint is usually delivered from the condenser by mechanical means into the press box, where it is first tramped or packed and then pressed to bale size. The air is exhausted through condenser vents, which should be larger in cross-sectional area than the lint flue in order to effect a satisfactory separation of the cotton and the air.

Cotton is packaged at the gin in two types of containers—the rectangular or so-called "square" bale weighing about 500 pounds and the cylindrical or "round" bale weighing approximately 250 pounds. During recent years about 98 percent of each crop has been packaged in square bales and about 2 percent in round bales. In

table 1 is given a description of American cotton bales. Standard or railway-compressed bales and high-density bales are made by compressing the square gin bales. The high-density bale is narrower and more symmetrical than the standard bale.

Approximately 6 yards of bagging, weighing usually 1¾ to 2 pounds per linear yard, is used to cover each except the round bales. After a bale has been sampled, 1 or 2 patches, which usually weigh 3 or 4 pounds each, are generally added. Tare (which includes bagging, patches, and ties) is allowed by southern mill rules up to 22 pounds for the square bale and 24 pounds for the compressed bale, and by New England rules up to 24 pounds per 500-pound bale.[8]

TABLE 1.—*Description of American cotton bales*

Kind of bale	Dimensions (approximate)	Weight (approximate)		Ties, per bale	
		Per bale	Per cubic foot	Usual	Weight
	Inches	*Pounds*	*Pounds*	*Number*	*Pounds*
Square, flat, gin, or uncompressed	54 by 27 by 45–48	500	12–14	6	9
Standard, or railway-compressed	56 by 28 by 18–22	500	25–30	8	9
High-density	59 by 24 by 19	500	32	9	9
Round	35 length, 22 diameter	250	33	0	0

Cotton presses at the gins may be of either single- or double-box and of screw, steam, or hydraulic type, the last being generally considered most desirable. Figure 29 shows a type that is being used increasingly. From 40 to 60 tons pressure is usually applied to the cotton by the press ram in making the square gin bales.

The packaging of American cotton has never been wholly satisfactory either in protecting the cotton or in economy in handling. The materials and methods of covering are controversial subjects. Prevalent practice is to use jute bagging and flat steel ties with a total tare weight of approximately 21 pounds.

PLANNING AND EQUIPPING NEW GINNING PLANTS

The best planned gin is one that is adequate for the needs of the community and its cotton, and yet is capable of the most economical operation commensurate with good service.

Planned capacity for a new ginning plant should be based on the expected seasonal and daily baleage, and should cover the regional needs for necessary additional conditioning, cleaning, and extracting. A plant having four 70-saw stands would gin approximately 26 bales if operating with a loose seed roll or approximately 37½ bales if operating with a tight seed roll in 8 hours of continuous operation—without interruptions such as are common for changing wagons, tying out bales, and the like. This is computed on the basis of 1,500 pounds of seed cotton, satisfactorily dry (8 to 12 percent moisture content), being required per bale of lint. Each gin saw, when operating continuously, would gin out approximately 6 to 8½ pounds of lint per hour from loose and tight seed rolls, respectively.

[8] For further packaging and tare information see U. S. Department of Agriculture multigraphed report, American Cotton Tare Practices and Problems, April 1933.

Figure 30 outlines six elementary ginning set-ups which incorporate balanced distribution of cleaning and extracting so that the service rendered to the farmer may be reasonably adapted to early clean pickings as well as to late weather-exposed "snaps." Upon the foundation of these lay-outs more extensive or complicated outfits can be developed. It usually will be preferable to add extracting rather than cleaning equipment, if by-pass provisions are incorporated,

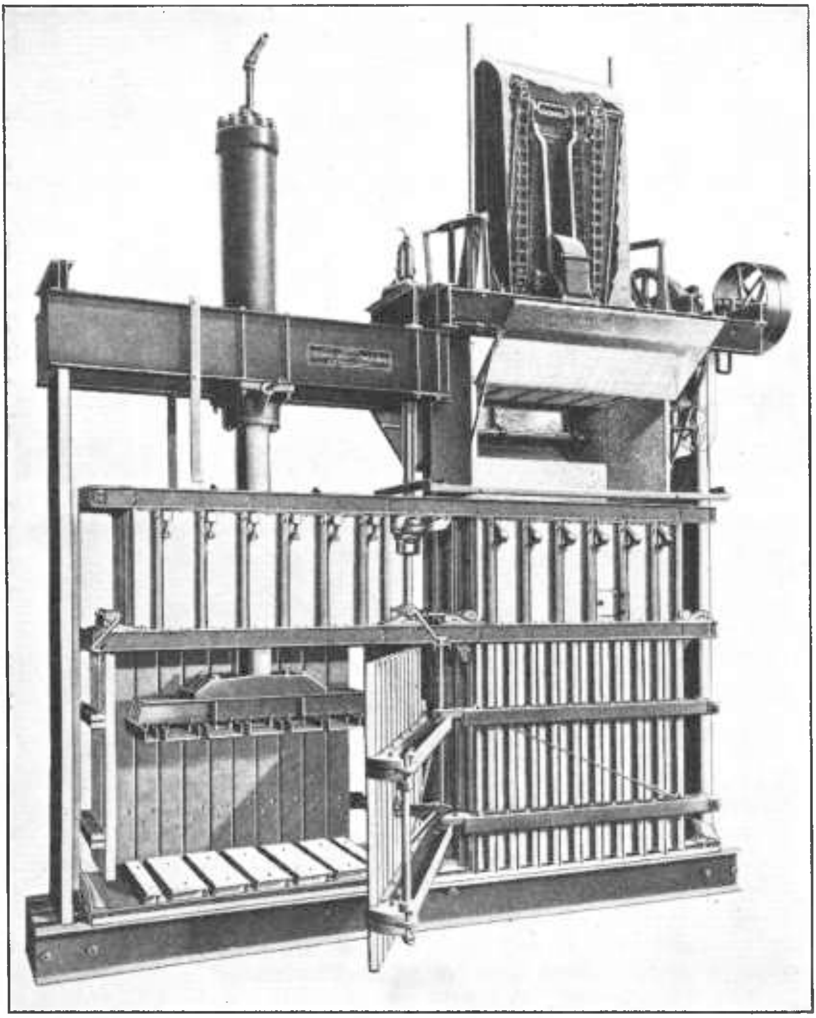


FIGURE 29.—Down-packing single-story double-box all-steel hydraulic cotton press.

because the double service of cleaning and extracting is thus obtained with no significant power increase.

Set-ups *A*, *D*, and *F* in figure 30 can be used only in mechanical systems having belt, gyrator, or screw-conveyor types of distributors. Set-ups *B*, *C*, and *E* are suitable for either pneumatic or mechanical systems, set-up *E* being especially suitable for cotton gins in the

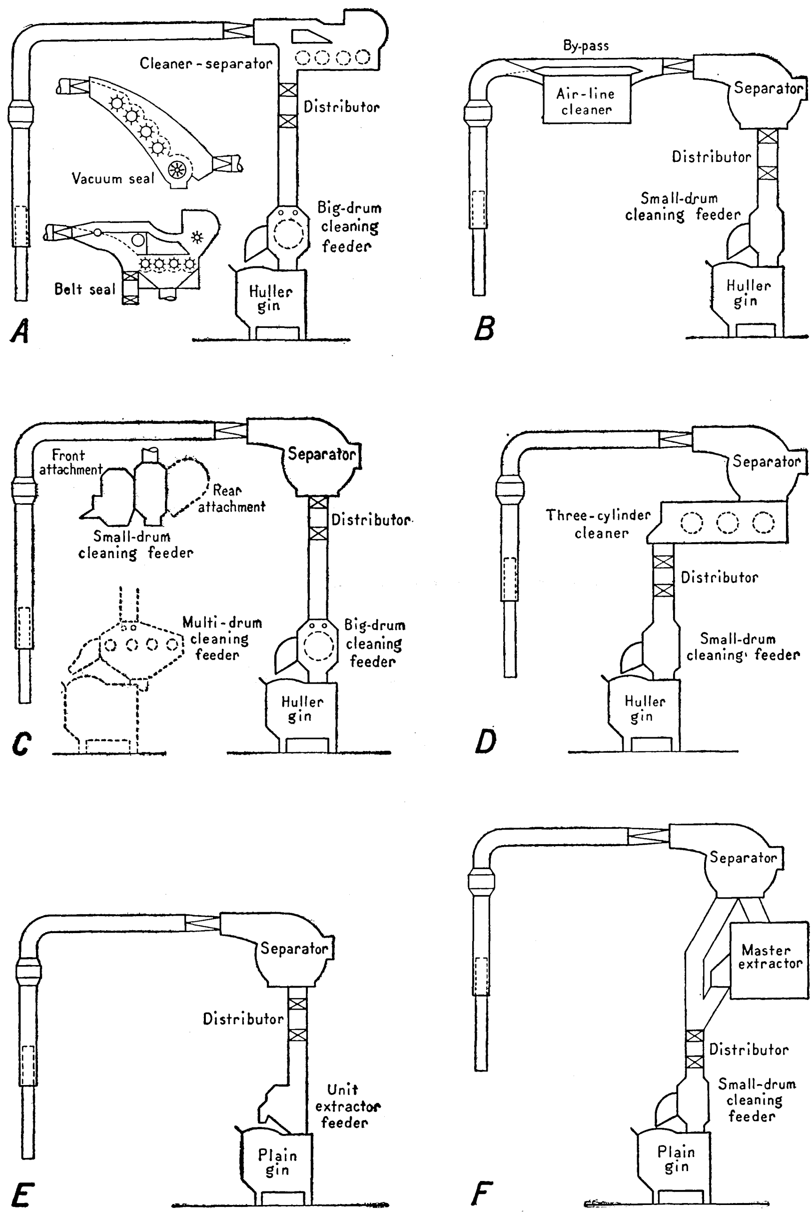


FIGURE 30.—Diagrams of simple ginning systems: *A*, Combined cleaner-separator, distributor, big-drum cleaning feeder, huller gin stand; *B*, air-line cleaner, separator (mechanical or pneumatic), distributor (or pneumatic chutes), small-drum cleaning feeders, huller gin stand; *C*, separator (mechanical or pneumatic), distributor (or pneumatic chutes), big-drum (multidrum) cleaning feeder, huller gin stand; *D*, separator (mechanical only), 3 (or more) cylinder cleaner, distributor, small-drum cleaning feeder, huller gin stand; *E*, separator (mechanical or pneumatic), distributor (or pneumatic chutes), unit extractor feeder, plain gin stand; *F*, separator (mechanical only), master extractor, distributor, small-drum cleaning feeder, plain gin stand.

southeastern area where plain gin stands are still popular. Alternate types of cleaner-separators are suggested in figure 30, *A*, and alternate types of cleaning feeders in figure 30, *C*.

Before final plans for a ginning plant can be made, it is necessary to determine whether a mechanical or a pneumatic distributing or feeding system will be used. Figure 31 illustrates these two general systems. In the mechanical system, the suction of cotton from the wagon is continuous, and any cotton that the gin stands cannot handle immediately is discharged at the overflow. This system is suitable for use with many combinations of conditioning, cleaning, and extracting machinery and is now the more usual system. The pneumatic system is intermittent in its suction from the cotton wagon,

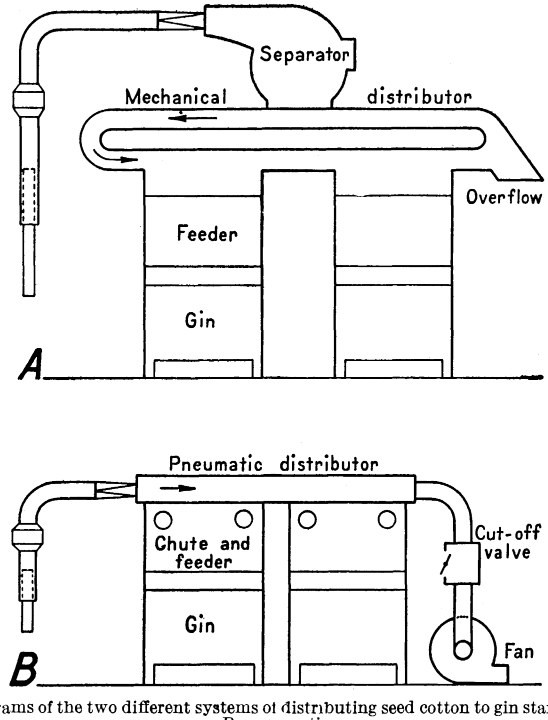


FIGURE 31.—Diagrams of the two different systems ol distributing seed cotton to gin stands: *A*, Mechnical; *B*, pneumatic.

and cannot feed the gin stands faster than they handle the cotton. There is no overflow in this type of system, which is not readily adaptable to the use of seed-cotton driers or of cleaners other than the air-line types. The pneumatic system uses a minimum of power, and where only moderately rough cotton is to be encountered it may be used successfully with unit extractors, as indicated in figure 30, *E*.

The selection of fans, cleaners, distributors, extractors, feeders, etc., will be influenced by the kind of distributing system chosen, but experience indicates that in any case huller gins rather than plain gins should be selected. Double-rib huller gins maintain a cleaner seed roll, are much better adapted to handling both clean-picked and roughly gathered cottons, and usually give samples having qualities

equal or superior to those from plain gins. The picker-roller adjustment permits handling varying degrees of roughness in the seed cottons, and the disposal of trash can be accomplished in double-rib huller gins without discharging it into the seed.

The power requirements of ginning-plant equipment can be totaled from the following tabulation, to ascertain what size of motor or engine may be required. It is a serious mistake to choose too small a motor or engine; the power provided may well be 10 percent in excess of the estimated net load. A rough estimate of the total power requirement for an average plant such as those diagrammed in figure 30, complete with fans, feeders, cleaner, separator, distributor, tramper, and hydraulic press, may be made on the basis of one-third horsepower for each gin saw. Thus, a 4–70 outfit (four 70-saw stands) would require an engine or motor having approximately $\frac{1}{3} \times 280 = 92$ horsepower. To be safe, a 100-horsepower unit would usually be selected.

Power required for operating ginning-plant machinery

Machine	*Horsepower*
Fan no. 30	10–15
Fan no. 35	14–30
Fan no. 40	20–40
Cleaner, air line	3½– 5
Cleaner, out-of-air	1½– 5
Distributor	2– 5
Separator	1½– 5
Cleaning feeder	1– 3
Unit feeder-extractor	2– 4
Master extractor	10–20
Brush gin stand, per 10 saws	1. 4– 2. 4
Air-blast gin stand, including air-blast fan, per 10 saws	2. 4– 3. 1
Press and tramper	15–20

Arrangements should be made, if possible, for an all-steel building of fireproof construction, one story high, with a bale crane, a wagon shed, and a seed conveyor to adjacent seed storage. Ample headroom should be allowed for driers and any future overhead equipment. It is best to locate seed scales in the ginning building, and to place them where the scale beams are easily accessible to the ginner and yet fully protected.

Engines and fans should be preferably in a separate compartment from the ginning machinery, to eliminate noise and to protect the power machinery from grit and dust.

Many good plans for ginning machinery have been worked out by manufacturers and ginners. Figure 32 shows the floor plan for a one-story electrically operated ginning plant for use by the United States Department of Agriculture. The cotton house and seed house may be included in a straight line or grouped in a cluster to suit local conditions. There are many good features about this plan that are desirable at any ginning plant, such as ample working space about the machinery, single-floor operations, and adequate headroom.

All gins, particularly in dry areas, should be grounded by adequate wiring to prevent fires caused by static electricity.[9]

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[9] See Circular 76, Fires in Cotton Gins and How to Prevent Them.

CARE, MAINTENANCE, AND OPERATION OF GINS

Certain operating practices and precautions are important from a ginner's standpoint. The spring and summer work that should be done preparatory to ginning include the inspection, repair or replacement, and adjustment of such items as saws, ribs, picker-rollers, brushes, air-blast nozzles, cotton piping, air-blast piping, lint flues and condensers, fans, cleaners, extractors, distributors, seed elevators, seed conveyors, press rams, and pumps.

The gin plant should be thoroughly cleaned at the beginning and periodically throughout the ginning season—say after each 50 bales have been ginned—and it should be left clean after the final shutdown to eliminate fire and other hazards. The saws should be left in such condition that they will not rust. It is a bad practice to loosen the rust with kerosene and then remove it with the cotton of the first patron. This and the practice of applying kerosene to saws that have been gummed up in ginning wet and dirty cotton have caused complaints from spinners of cotton. Artificial drying prevents annoyance from ginning wet seed cotton.

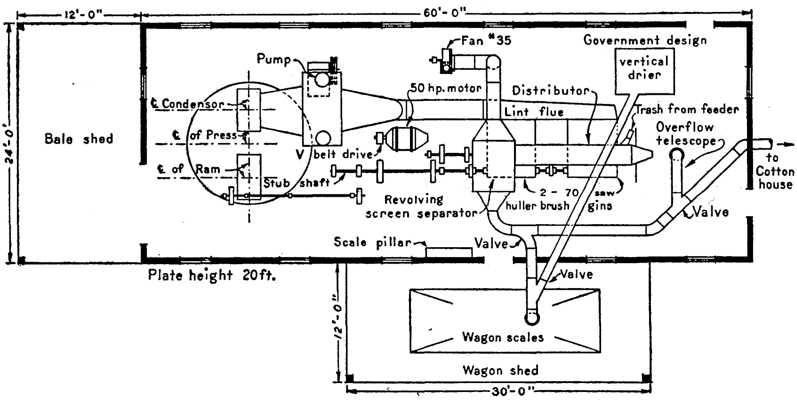

FIGURE 32.—Plan for one-story cotton ginning establishment to be used by Department of Agriculture.

Distributors are frequently sources of trouble, especially in wooden buildings which may settle or become warped. If the distributor is braced by horizontal stiff-arms straight to the wooden walls, the distributor will often be pulled out of line so much as to the cause the upper portion to serpentine in one direction while the lower part twists in the reverse. Weights of cleaning machinery, when partly supported by the distributor, may still further aggravate this twist and misalignment. These factors cause the distributor pulleys to wear off at one place faster than another, and cause the belt spikes to be ground off on the underside of the belts when the pulley grooves disappear, so that the spikes fall into the machinery.

It is good practice to sharpen the gin saws after every 500 to 1,000 bales, depending on the severity of the work. If the teeth of the saws become dull, worn, broken, or out of shape, the ginning capacity is reduced, and the seed roll becomes tighter because both the ginning and lint-doffing actions are impaired. The fibers that are not cleared, or removed from the saw teeth, accompany the saw through the roll

box again and cause additional napping of the lint. They also increase fire hazards. The moting action of the gin is impaired under these poor ginning conditions. When saws are not adequately repaired and properly trained, there is danger that they will "drag" the ribs, which causes wear on both saws and ribs. Lack of alignment and clearance further injure the quality of the sample, and cause additional fire hazard. Gumming and filing should be done in such a way as to keep the saws circular, and with the factory pitch. The leading edge of the tooth should be practically parallel to the surface of the main ribs at the position where the teeth pass through with the lint. This edge of the tooth should have no burs, and should be neither round nor rough, and the tooth should taper from base to point. Some ginners prefer to gum the saws with a machine and then finish dressing the teeth by hand with a flat file.

The ribs should be replaced or repaired if worn, so that they have clean, straight edges with the sharpness barely removed. The saw slots should be approximately three saw thicknesses in width, 0.125 inch being considered a maximum allowable and 0.117 inch being about the average for a factory job. If ribs are allowed to become badly worn, both the ginning capacity and the quality of the sample are reduced. The ribs can become so badly worn that seed will readily pass through the rib space or slot along with the lint, and cause the undesirable addition of seed to the ginned lint. Under these conditions chokages and fire hazards often result. Ribs can be repaired by building up worn places by arc welding and then grinding to obtain new surfaces. Ribs can be cadmium plated, painted, or greased to prevent rust. At the end of a season, the ribs and saws should be oiled with crude oil or other protective lubricant. When the ginning begins, kerosene or white gasoline should be used to remove this protective coating.

Picker rollers should be checked for missing spikes, and should be properly aligned so that the spikes are centered between saws. During the early part of the season, when clean hand-picked cotton is being ginned, the picker roller should be near enough to the huller ribs to prevent any good locks of cotton from being expelled but far enough away to avoid chokages. Later in the season, when rough cotton is encountered, the picker roller should be moved away from the ribs in order to give a better discharge of the burs and other foreign matter. The distance the saws protrude through the huller ribs is important and should be checked against factory settings.

Brushes should be protected from vermin and rodents during idle seasons, and before being used should be refilled with bristles where necessary and then balanced. This will insure adequate and uniform doffing, and will contribute to smooth ginning. Ball-bearing balancing rigs or knife edges may be home-made by the ginner, if he is familiar with the ways and means for such work, but factory repairs are generally advisable.

For saw speeds between 400 and 550 revolutions per minute, with 12-inch saws, the peripheral speed of the brushes should be approximately 6,666 linear feet per minute. This figure, 6,666, is easily remembered.

All operators of brush gins should give attention and periodical inspection to the wind boards that are placed between the upper parts of the saws and the brushes. It is important that the position and proportions of this dividing board be maintained. Some manufacturers provide their patrons with cheap metal covers to do this when the board shows signs of wear. If the board is not protected or replaced when its position has been affected by wear, it will change the volume and direction of the brush blast upon the saws. It may seriously affect both the doffing and the moting actions, and it thus becomes a potential menace to making good samples. Likewise, the backboard, which is above the brush at the back of the gin stand, must be kept free from wear, and it should be kept sufficiently close to the brush tips to prevent the accumulation of "fly" and lint in a wad or mass above the brush.

Air-blast nozzles not only should be given occasional inspection to assure correct position and freedom from chokage, but also should be tested with a U-tube water gage during operation of the gin in order that correct doffing pressure may be maintained. In practice the nozzle position is about one-eighth inch or more from the tips of the saw teeth, and the pressure should be from 10 to 16 inches water gage depending on regional conditions and types of cotton handled.

All cotton piping, lint flues, adapters, and fan connections should be airtight and unobstructed. Leaky joints can be repaired cheaply by using strips of adhesive wrapping tape of heavy manila paper. Fans should be very carefully checked with regard to condition of wheel, speed, pressure, and operating factors. Air volumes delivered by fans vary directly with the speed, and driving power for fans varies as the cube of the speed; hence the conditions for best and most economical operation are not likely to be obtained by chance but should be worked out to suit each individual installation.

Backlash frequently results from excessive pressure in the lint flue, which may be caused by too high speeds of the air-blast fan or the brushes or by too small a condenser. This in turn may result in trouble with the gin stand at one or the other end of the battery.

Seed elevators and conveyors should be of the screw or belt type, in preference to seed-blowing devices which are inefficient and more costly in operation.

Press rams should be properly packed at reasonable intervals, and petroleum oils rather than water should be used as the hydraulic fluid. Although such oils involve a slight expense, they prevent corrosion and protect the polished plunger surfaces and the working parts of the pump.

Care of the buildings and premises to avoid roof leaks, to protect the machinery, and to prevent serious fire hazards by frequent removal of all clinging lint and dust, is essential for the good gins of today.

Belts should be removed at the end of the ginning season, rolled up, and stored in a dry, protected place until wanted again. If V-belts cannot be readily removed, the tension in them should be released during the idle period.

Stock bolts, shafting, small tools, etc., should be protected with a thin film of oil, preferably by being dipped in a mixture of lubricating oil and gasoline.

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